



Northview Heights Midrise Development

246 Penfort Street
Pittsburgh, Pennsylvania 15214

Allies & Ross Management and Development Corporation
(ARMDC)

200 Ross Street
Pittsburgh, 15219

February 9, 2022



SPECIFICATIONS

PHFA No. 2021-156

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1.1 PROJECT MANUAL VOLUME 1 Review Set - Not for Construction

- A. Northview Heights Midrise Development.
- B. Allies & Ross Management and Development Corporation (ARMDC).
- C. Pittsburgh, Pennsylvania.
- D. Owner Project No. PHFA No. 2021-156.
- E. Architect Project No. 2040 .
- F. .
- G. .
- H. Fukui Architects.
- I. 205 Ross St .
- J. Pittsburgh, PA 15219 .
- K. Phone: 412-281-6001 .
- L. Fax: 412-281-6002 .
- M. Website: www.farpc.com .
- N. Issued: 09/24/2021 .
- O. Copyright 2021 Fukui Architects PC . All rights reserved.

END OF DOCUMENT 00 01 01

DOCUMENT 00 01 07 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Fukui Architects .
2. RA404265 .
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.

B. Civil Engineer:

1. Red Red Swing, Group .
2. PE-053534-E .
3. Responsible for 02 41 00, Divisions 31-33 Sections except where indicated as prepared by Landscape Architect .

C. Landscape Architect:

1. UpStudio Landscapes .
2. LA002724 .
3. Responsible for 32 01 90.33, 32 28 70, 32 31 00, 32 33 00, 32 84 00, 32 91 19, 32 93 90, 32 94 13 .

D. Structural Engineer:

1. Providence Engineering .
2. .
3. Responsible for 03 30 00, 04 22 00, 05 12 00, 06 17 53 .

E. Fire-Protection Engineer:

1. .
2. PE085703 .
3. Responsible for Division 21 .

F. Plumbing Engineer:

1. Iams Consulting .
2. 054899-E .
3. Responsible for Division 22 .

G. HVAC Engineer:

1. Iams Consulting .
2. 054899-E .
3. Responsible for Division 23 .

H. Electrical Engineer:

1. Iams Consulting .
2. 054899-E .
3. Responsible for Divisions 26, 28 .

END OF DOCUMENT 00 01 07

DOCUMENT 00 01 15 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled Northview Heights Midrise , dated December 10, 2021 , as modified by subsequent Addenda and Contract modifications.
- B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:
 - 1. In the following pages labeled Drawing Index numbered 1 - 12 .

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THIRD FLOOR SHEAR WALL PLAN
S304 FOURTH FLOOR SHEAR WALL PLAN
FOURTH FLOOR SHEAR WALL PLAN
S401 STRUCTURAL DETAILS
STRUCTURAL DETAILS
S402 STRUCTURAL DETAILS
STRUCTURAL DETAILS
S501 STRUCTURAL DETAILS
STRUCTURAL DETAILS
S502 STRUCTURAL DETAILS
STRUCTURAL DETAILS
S503 STRUCTURAL DETAILS
STRUCTURAL DETAILS
S504 STRUCTURAL DETAILS
STRUCTURAL DETAILS

PLUMBING

P00 LEGEND AND GENERAL NOTES
LEGEND AND GENERAL NOTES
P101 FIRST FLOOR PLUMBING PLAN
FIRST FLOOR PLUMBING PLAN
P102 SECOND FLOOR PLUMBING PLAN
SECOND FLOOR PLUMBING PLAN
P103 THIRD FLOOR PLUMBING PLAN
THIRD FLOOR PLUMBING PLAN
P104 FOURTH FLOOR PLUMBING PLAN
FOURTH FLOOR PLUMBING PLAN
P105 ROOF VENT PENETRATION PLAN
ROOF VENT PENETRATION PLAN
P201 ENLARGED PLUMBING PLAN
ENLARGED PLUMBING PLAN
P202 ENLARGED PLUMBING PLAN
ENLARGED PLUMBING PLAN
P203 ENLARGED PLUMBING PLAN
ENLARGED PLUMBING PLAN
P204 ENLARGED PLUMBING PLAN
ENLARGED PLUMBING PLAN
P301 WATERRISER DIAGRAMs
WATERRISER DIAGRAMs
P302 WATERRISER DIAGRAMs
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P303 WATERRISER DIAGRAMs
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SANITARY RISER DIAGRAMs
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SANITARY RISER DIAGRAMs
P307 SANITARY RISER DIAGRAMs
SANITARY RISER DIAGRAMs
P308 SANITARY RISER DIAGRAMs
SANITARY RISER DIAGRAMs
P401 DETAILS
DETAILS
P402 DETAILS
DETAILS
P403 RADON SYSTEM DETAILS
RADON SYSTEM DETAILS
P501 SCHEDULES
SCHEDULES

MECHANICAL

M000 MECHANICAL COVERSHEET
MECHANICAL COVERSHEET
M101 MECHANICAL FIRST FLOOR PLAN
MECHANICAL FIRST FLOOR PLAN
M102 MECHANICAL SECOND FLOOR PLAN
MECHANICAL SECOND FLOOR PLAN
M103 MECHANICAL THIRD FLOOR PLAN
MECHANICAL THIRD FLOOR PLAN
M104 MECHANICAL FOURTH FLOOR PLAN
MECHANICAL FOURTH FLOOR PLAN
M201 MECHANICAL PIPING FIRST FLOOR PLAN
MECHANICAL PIPING FIRST FLOOR PLAN
M202 MECHANICAL PIPING SECOND FLOOR PLAN
MECHANICAL PIPING SECOND FLOOR PLAN
M203 MECHANICAL PIPING THIRD FLOOR PLAN
MECHANICAL PIPING THIRD FLOOR PLAN
M204 MECHANICAL PIPING FOURTH FLOOR PLAN
MECHANICAL PIPING FOURTH FLOOR PLAN
M300 MECHANICAL ENLARGED ONE BEDROOM UNIT PLANS
MECHANICAL ENLARGED ONE BEDROOM UNIT PLANS
M301 MECHANICAL ENLARGED ONE BEDROOM UNIT PLANS
MECHANICAL ENLARGED ONE BEDROOM UNIT PLANS
M302 MECHANICAL ENLARGED TWO BEDROOM UNIT PLANS
MECHANICAL ENLARGED TWO BEDROOM UNIT PLANS
M303 MECHANICAL ENLARGED TWO BEDROOM UNIT PLANS
MECHANICAL ENLARGED TWO BEDROOM UNIT PLANS
M400 MECHANICAL DETAILS
MECHANICAL DETAILS
M401 MECHANICAL DETAILS
MECHANICAL DETAILS
M500 MECHANICAL SCHEDULES
MECHANICAL SCHEDULES
M501 MECHANICAL SCHEDULES
MECHANICAL SCHEDULES
M502 MECHANICAL SCHEDULES
MECHANICAL SCHEDULES

ELECTRICAL

E000 ELECTRICAL COVERSHEET
ELECTRICAL COVERSHEET
E010 ELECTRICAL SITE PLAN
ELECTRICAL SITE PLAN
E101 ELECTRICAL FLOOR PLANS
ELECTRICAL FLOOR PLANS
E102 ELECTRICAL FLOOR PLANS
ELECTRICAL FLOOR PLANS
E103 ELECTRICAL FLOOR PLANS
ELECTRICAL FLOOR PLANS
E104 ELECTRICAL FLOOR PLANS
ELECTRICAL FLOOR PLANS
E200 ELECTRICAL ENLARGED FLOOR PLANS
ELECTRICAL ENLARGED FLOOR PLANS
E201 ELECTRICAL ENLARGED UNIT PLANS
ELECTRICAL ENLARGED UNIT PLANS
E202 ELECTRICAL ENLARGED UNIT PLANS
ELECTRICAL ENLARGED UNIT PLANS
E203 ELECTRICAL ENLARGED UNIT PLANS
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E204 ELECTRICAL ENLARGED UNIT PLANS
ELECTRICAL ENLARGED UNIT PLANS
E205 ELECTRICAL ENLARGED UNIT PLANS
ELECTRICAL ENLARGED UNIT PLANS
E206 ELECTRICAL ENLARGED UNIT PLANS
ELECTRICAL ENLARGED UNIT PLANS
E300 ELECTRICAL POWER DISTRIBUTION RISER & DETAILS
ELECTRICAL POWER DISTRIBUTION RISER & DETAILS
E301 ELECTRICAL FIRE ALARM RISER & DETAILS
ELECTRICAL FIRE ALARM RISER & DETAILS
E302 ELECTRICAL CATV / PHONE RISER & DETAILS
ELECTRICAL CATV / PHONE RISER & DETAILS
E303 ELECTRICAL LIGHTING CONTROL DIAGRAMS
ELECTRICAL LIGHTING CONTROL DIAGRAMS
E304 ELECTRICAL DETAILS
ELECTRICAL DETAILS
E400 ELECTRICAL SCHEDULES
ELECTRICAL SCHEDULES
E401 ELECTRICAL SCHEDULES
ELECTRICAL SCHEDULES

FIRE PROTECTION

FP00 FIRE PROTECTION LEGEND AND GENERAL NOTES
FIRE PROTECTION LEGEND AND GENERAL NOTES
FP101 FIRE PROTECTION PLAN
FIRE PROTECTION PLAN
FP102 FIRE PROTECTION PLAN
FIRE PROTECTION PLAN
FP103 FIRE PROTECTION PLAN
FIRE PROTECTION PLAN
FP201 ENLARGED FIRE PROTECTION PLAN
ENLARGED FIRE PROTECTION PLAN
FP301 DETAILS
DETAILS

FIRE ALARM

FA100 FIRE ALARM FLOOR PLANS
FIRE ALARM FLOOR PLANS
FA101 FIRE ALARM FLOOR PLANS
FIRE ALARM FLOOR PLANS
FA200 FIRE ALARM ENLARGED UNIT PLANS
FIRE ALARM ENLARGED UNIT PLANS
FA300 FIRE ALARM & RISER DETAILS
FIRE ALARM & RISER DETAILS

DOCUMENT 00 26 00 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 25 00 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect . Procurement Substitution Request must be made in writing in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than 5 days prior to date of bid opening.
 - 2. Submittal Format: Submit three copies of each written Procurement Substitution Request, using CSI Substitution Request Form 1.5C.

3. Submittal Format: Submit Procurement Substitution Request, using format provided on Project Web site.
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.
 - 3) Samples where applicable or when requested by Architect.
 - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES .
 - 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
 - c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
 - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 00 26 00

DOCUMENT 00 31 32 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. Soil-boring data for Project, obtained by Sci-Tek Consultants, Inc. , dated September 26, 2017 , is available for viewing as appended to this Document.
- D. A geotechnical investigation report for Project, prepared by Sci-Tek Consultants, Inc. , dated September 26, 2017 , is available for viewing as appended to this Document.
 - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.
- E. Related Requirements:
 - 1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
 - 2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.

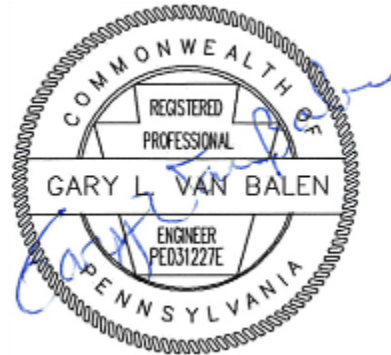
END OF DOCUMENT 00 31 32

GEOTECHNICAL EXPLORATION REPORT

*Housing Authority of the City of Pittsburgh (HACP)
Northview Heights Midrise
Pittsburgh, PA.*

*For:
Rothschild Doyno Collaborative
2847 Penn Avenue
Pittsburgh, PA 15222*

*Prepared by:
Sci-Tek Consultants, Inc.
Edward P. Vesely, PE
Gary L. Van Balen, PE*



*Sci-Tek Project Number 17-781
September 26, 2017*



Civil, Environmental and Geotechnical Engineering, and Surveying Answers

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APPENDICES

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APPENDIX B: Inspector's Field Logs

APPENDIX C: Laboratory Test Reports

APPENDIX D: Definitions and Limitations

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1.0 INTRODUCTION

1.1 BACKGROUND

The Housing Authority of the City of Pittsburgh (HACP) has engaged Rothschild Doyno Collaborative (RDC), a Pittsburgh-based architecture and urban design firm, to design a new Midrise Building (Project) at the Northview Heights community. RDC has assembled a team of professional engineers, landscape architects, and surveyors for the Project. As part of this team, Sci-Tek Consultants, Inc. (Sci-Tek) was engaged by RDC to perform a subsurface investigation and prepare this geotechnical exploration report for the Project.

The Northview Heights property is located approximately 2.5 miles north of downtown Pittsburgh in the 26th Ward. The Northview Heights property is approximately 88 acres, and includes multi-family apartment dwellings, one high rise building and other structural and non-structural amenities. The proposed Midrise building site (Site) will occupy approximately 4 acres of the Northview Heights along east side of Penfort Street. Originally, there were five multi-family dwellings at the Site, which were demolished in 2011. After the demolition, the Site was regraded and seeded.

The proposed Midrise building will consist of two 4-story wings with a one and one-half story Community Center located between each wing. Each wing is approximately 210 feet long by 63 feet wide. The Community Center area is approximately 65 feet by 63 feet. The proposed elevation of the first floor of the building is 1162.80 feet.

An at-grade parking lot is planned for the Midrise building, which will be located north of the building and contain approximately 45 parking spots and a trash pick-up area. The lot will include two short access roads to Penfort Street. The parking area is approximately 190 feet by 110 feet.

1.1.1 Existing Site Topography

The existing site slopes gently (5 to 7 percent), but irregularly from north to south. The existing grade and the north end of the site is approximately 1168 feet. To the south, the grade varies from 1141 feet to 1150 feet. Below the eastern portion of the south side of the site is a steep, wooded, and undeveloped slope. The slope of this hillside is approximately 50 percent. The western portion of the south side of the Site transitions gradually to Larmar Street. The Site is covered with grass and appears to be mowed periodically. There are multiple trees scattered throughout the Site.

1.1.2 Proposed Grading

In general, the site will be graded to follow the existing contours and slope from North to South. The parking area will slope at approximately 2 percent from

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North to South. The area adjacent to the west wing of the building will be sloped from northwest to southeast mirroring the grade of Penfort Street. On the east side, the slope is relative flat along the northern portion of the wing and then steepens toward the south.

Grade walls will be used to overcome the change in grade between the north end and south end of each wing. At its maximum point; approximately 11 feet of the grade wall will be exposed below the first-floor elevation.

Behind the building's Community Center will be a gently sloping fill embankment that will be designed for a patio/garden.

- 1.1.3 To facilitate the design, Sci-Tek performed a geotechnical exploration from May 23 through May 31, 2017. Our work was performed by Edward Vesely, PE, Senior Civil Engineer under the direct supervision of Gary L. Van Balen, PE, Engineering Manager for Sci-Tek. Drilling was performed by Sci-Tek's subcontractor Geo-Environmental Drilling Company, Inc. of Pittsburgh, Pennsylvania. The materials testing was performed by Geotechnics, Inc. of East Pittsburgh, Pennsylvania.

1.2 AUTHORIZATION

Sci-Tek performed this geotechnical exploration in general accordance with our proposal to Rothschild Doyno.

1.3 REPORT USE

- 1.3.1 Sci-Tek prepared this report in accordance with generally accepted soil and foundation engineering practices for Rothschild Doyno to use for the design of the Midrise Building and ancillary facilities. No other warranty, expressed or implied, is made as to the professional advice included in this report.
- 1.3.2 No party, other than Sci-Tek's client for which this report was originally written, is entitled to rely on this report without Sci-Tek's written consent. If any other party relies on or reuses this report without Sci-Tek's written permission, Sci-Tek shall not be liable for any claims, damages, losses, or expenses resulting from such unauthorized reliance or reuse. If others base decisions on the conclusions, recommendations, or data obtained in this report, such decisions are the responsibility of those others.
- 1.3.3 If the final design differs with respect to function, purpose, location, layout or elevation from that on which we based this report, Sci-Tek must review the applicability of our recommendations with respect to the proposed final design.

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- 1.3.4 The conclusions and recommendations submitted in this report are based upon limited data obtained at the test boring locations. This report does not reflect any variations that naturally and most likely occur between the test borings. The nature and extent of variations between the test borings will not become evident until additional test borings are drilled, or construction is performed at the Site. Consequently, if at any time fill, soil, rock, and groundwater conditions appear to be different from those described herein, Sci-Tek must be advised at once so that we can reevaluate the recommendations considering actual site conditions.
- 1.3.5 Since subsurface conditions change with time, the data obtained, conclusions and recommendations in this report may become obsolete depending on the nature and extent of any changes and the amount of time that passes.

1.4 PURPOSE

- 1.4.1 Perform a geotechnical subsurface exploration for a proposed Mid-Rise Building and parking lot.
- 1.4.2 Present opinions (conclusions) on the following based on the data obtained at the test boring locations, visual observations, laboratory test results, and the analyses performed:
- Fill conditions,
 - Soil conditions,
 - Rock conditions, and
 - Groundwater conditions (if encountered).
- 1.4.3 Present recommendations on the following based on the data obtained at the test boring locations, visual observations, laboratory test results, and the analyses performed:
- Foundation type and depth for the proposed Mid-Rise Building.
 - Foundation design parameters for the materials encountered at the test boring location, including estimated allowable bearing pressure and estimated settlement.
 - Site work,
 - Embankment construction,
 - Retaining structures,
 - Slabs,
 - Paving, and
 - Subsurface drainage.

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1.5 SCOPE-OF-WORK PERFORMED

- 1.5.1. Developed a written purpose, scope of work, proposed cost, and schedule for our proposed geotechnical investigation. We use this for project planning and management.
- 1.5.2. Reviewed available information for the site.
- 1.5.3. Selected a drilling subcontractor based on price and availability. For this proposal, we obtained estimated drilling prices from, and used Geo-Environmental Drilling Co, Inc.
- 1.5.4. Sci-Tek staked or marked proposed test boring locations with respect to existing features that appear in the field and on available site drawings or Google Earth satellite photographs. Test boring elevations were estimated using Google Earth, and were later surveyed during the Site survey.
- 1.5.5. Performed a PA-1 Call for final design according to PA Act 287, which provided an indication of the presence of subsurface utilities at the Site through scaled or unscaled drawings/sketched or verbal responses provided by participating utility companies. Our drilling subcontractor also made a separate PA-1 Call for excavation to cover the actual drilling operations. This caused participating utility companies to mark subsurface utilities in the field with paint and/or flags.
- 1.5.6. Prepared a table showing the purpose, elevation, planned depth, and termination criteria for each test boring. This was used for managing the test boring program during drilling and facilitated changes to the program when necessary.
- 1.5.7. Drilled ten (10) standard test borings at the approximate locations shown on the Test Boring Location Plan. Continuous split-spoon sampling was performed in all test borings to the planned depth, or to the top of rock (TOR) if encountered at a shallower depth. If an obstruction (abandoned foundation, etc.) was encountered, the boring was relocated within 5-ft and re-drilled at additional cost. Drilling and sampling was performed in general accordance with PennDOT and ASTM standards.

Test borings were backfilled with drill cuttings to within two (2) feet of the ground surface. This was followed with a two (2) foot plug of ready-mix concrete. Any excess drill cuttings were spread on landscaped areas near the test borings and graded to blend with existing contours. No other site restoration was performed.

- 1.5.8. Provided a full-time project representative during drilling to perform the following tasks:

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- Observed that the drilling work was in general conformance with applicable standards.
 - Visually described and logged the soil and rock samples obtained noting subsurface conditions relative to the type, depth, and distribution of materials encountered.
 - Modified the drilling and sampling program based on the actual conditions encountered.
- 1.5.9. Selected representative samples of the soil recovered for laboratory testing of physical properties. Laboratory testing included sieve analysis, hydrometer, Atterberg Limits, USCS soil classification, and water content. Sci-Tek used Geotechnics, Inc. of Pittsburgh, Pennsylvania for laboratory testing services.
- 1.5.10. Developed Inspector's Field Logs of the subsurface data obtained at the test boring locations. Inspector's Field Logs have been provided in PennDOT format.
- 1.5.11. Estimated applicable engineering parameters for the materials encountered at the test boring locations as required.
- 1.5.12. Prepared estimates of settlement and bearing capacity based on field data, and prepare recommendations for foundation design as required.
- 1.5.13. Reviewed the design during its development for conformance with our conclusions, recommendations, and technical specifications.
- 1.5.14. Prepared this report, which contains our conclusions and recommendations for the design of foundations, subgrade preparation, subsurface drainage, and structural backfill and compaction requirements based on the data obtained at the test boring locations.

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2.0 CONCLUSIONS

In our opinion, the following conclusions may be presented based on our analysis of the data obtained at the test boring locations.

2.1 FILL CONDITIONS

In our opinion, the fill encountered in the test borings appears to be loosely placed and contains objectionable and over-size particles. The fill in its current state would not be suitable for shallow foundations or other proposed structures. However, if the fill was excavated, properly processed to remove objectionable material, to reduce oversized particles, and to improve its consistency and then properly placed and compacted, it could be used to support the proposed building on shallow foundations.

2.2 SOIL CONDITIONS

In our opinion, the residual soil encountered in the test borings is suitable for supporting shallow, individual, continuous, or mat foundations.

2.3 BEDROCK CONDITIONS

In our opinion, the limestone can support deep foundations, but because of its depth and weathering, shallow foundations are a more suitable alternative for supporting the proposed building and other structures.

2.4 GROUNDWATER CONDITIONS

In our opinion, seepage from the fill above the residual soil may occur when the fill is over-excavated. To mitigate the accumulation of water, it will be necessary to manage the water to effectively keep the excavations and the soil being placed and compacted dry.

2.5 COAL SEAMS

Based on our research of public geologic information the elevation of the Pittsburgh Coal is such that it could have outcropped near the proposed parking lot at the northern end of the site. However, the Pittsburgh Coal was not encountered in any of the test borings. In our opinion, the proposed facilities (building and parking lot) are either below the elevation of the Pittsburgh Coal and it has been eroded away, or, if there was Pittsburgh Coal near the proposed parking lot, it was probably strip-mined out during earlier development at the site. There is no active "shallow mining" at the site, and mine subsidence should not be an issue. Sci-Tek in no way guarantees that there will not be any remnants of coal on the site from previous fill placement, as we did encounter trace amounts in one of the test borings.

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2.6 POTENTIALLY EXPANSIVE SHALE

Potentially expansive shale was not encountered in the test borings and in our opinion, it is unlikely that any will be discovered in proposed excavations for the project. However, Sci-Tek in no way can guarantee that there will not be any expansive shale encountered on the site. This is because the reality is that we drilled a limited number of test borings and they provide limited information for a relatively large site.

2.7 SITE CLASSIFICATION FOR SEISMIC DESIGN

In our opinion, the IBC Site Class for seismic loading is Site Class C. The bedrock encountered in the test boings was generally weathered, and no borings were advanced to a depth where nonweathered rock was encountered. Thus, our estimate of Site Class is based on the rock encountered and our experience with test borings drilled deeper into rock in the same geologic formation.

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3.0 RECOMMENDATIONS

3.1 ADDITIONAL STUDY

No additional study is recommended.

3.2 SHALLOW FOUNDATIONS AND GRADE WALLS

Use a Presumptive Bearing Value of 1.5-tsf (3,000-psf) for spread foundations bearing on fill (prepared as in Section 3.3.4 below), residual soil, rock, or weathered rock. Under this design parameter, the expected total and differential settlement should be less than 1 inch.

If unsuitable material is found at the bearing elevation over-excavate and replace with structural fill. Place structural fill as indicated in this report to improve the bearing capacity and reduce the settlement.

Design spread foundations so that the base of the foundation is below the frost depth for the Site, which is 36-inches (based on Fig.-7 of NAVFAC DM-7.1 Soil Mechanics).

Design all foundations to resist and/or accommodate all hydrostatic pressure arrangements that are likely to operate on these elements as a consequence of short-term hydraulic pressure conditions in the surrounding and/or adjacent soil. The hydrostatic pressure arrangements are likely to include the effects of local groundwater conditions that are described in Section 2.4 above.

To design the grade walls, use a lateral pressure on the backs of the walls that is composed of two parts. The first part is a uniform, rectangular pressure distribution equal to the sum of the dead and live loads on the floor behind the walls. Add to this a triangular, at-rest earth pressure distribution that varies from 0-psf at the top of the fill behind the walls to a maximum at the base of the walls. Use a unit weight of 125-pcf for the fill behind the walls and an at-rest pressure coefficient of 0.53 to calculate the maximum at-rest earth pressure.

Also apply a triangular, at-rest earth pressure distribution on the front of the walls that varies from 0-psf at the ground surface in front of the walls to a maximum at the base of the walls. Use the same at-rest pressure coefficient to calculate the maximum on the front side of the walls.

The at-rest lateral pressure on the front of the walls is toward the building, while the lateral pressure on the backs of the walls is away from the building.

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The information above assume that there is no hydrostatic pressure in front of or behind the walls and that the design will incorporate free drain material directly against the walls and a method drain accumulated groundwater from both behind and in front of the walls.

3.3 SUBGRADE PREPARATION

3.3.1 Clearing and Grubbing

Prior to fill placement and foundation construction, strip and clear proposed construction areas of all deleterious materials such as topsoil, organic or other objectionable materials, including that described in the following Section 3.3.2.

3.3.2 Subgrade Preparation

During the over-excavation of the existing fill material, if concrete foundations or floor slabs are encountered, each should be evaluated by the Geotechnical Engineer relative to its location/elevation and that of the proposed foundations, floor slab, and other utilities/structures for the building. In general, existing concrete foundations and floor slabs within the footprint of the proposed building, or beneath proposed foundations should be removed and the over-excavation continued to the underlying residual soil. If, the existing concrete foundations or floor slabs can be exposed on all side and it is visually apparent they were constructed in residual soil, they may be left in place unless they are immediately at, above, or just below proposed foundations. Over-excavated areas should be backfilled with structural fill or lean concrete.

The Geotechnical Engineer should visually inspect the subgrade. Prior to fill placement and foundation construction, proof-roll the subgrade to the satisfaction of the Geotechnical Engineer. Subgrade soils that are visually unsuitable, or that pump or yield under the compaction equipment, or which cannot be compacted to the minimum required density should be scarified and re-compacted to the minimum density indicated in Section 3.3.3. Material that cannot be compacted as required should be brought to the attention of the Geotechnical Engineer who may recommend over-excavation and replacement with suitable fill in accordance with Section 3.3.3.

3.3.3 Structural Fill, Suitable Material, Select Coarse Aggregate, Placement and Compaction

Backfill the over-excavated material with structural fill composed of suitable on-site materials, or select off-site borrow.

Structural fill is defined as any fill material that meets the requirements for “suitable material,” which is placed according to the recommendations below.

GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

Suitable material is defined as materials that are combinations of the ASTM Classifications of GW, GP, GM, GC, SW, SP, SM, and SC and free of organics and other objectionable material such as debris, “redog” (burned coal refuse) and wood. Provisionally suitable soils include those, which are combinations of the ASTM Classifications of ML, MH, CL and CH. Provisionally suitable material shall be placed in noncritical zones of fills at the direction of the geotechnical engineer. PennDOT No. 57 or 2A, or other off-site suitable borrow may be used provided it is composed of natural soil meeting the ASTM classification requirements cited above.

Select coarse aggregate material should be AASHTO No. 57 coarse aggregate (or equivalent graded material with no particles finer than the No. 200 sieve). All select coarse aggregate material should be free of foreign debris, refuse, vegetative matter, soft unsound particles, frozen, deleterious, or other objectionable material. Select coarse aggregate material should be used for backfill immediately behind all grade walls, retaining structures and for underdrains.

To facilitate proper compaction of the fill, place fill in horizontal, maximum 8-inch thick loose lifts when using relatively heavy compaction equipment, or in horizontal, 4-inch thick or smaller loose lifts when using relatively light compaction equipment.

Compact fill material used for establishing subgrade and/or beneath foundations, and/or other structural elements to at least 95 percent of the maximum dry density at plus or minus two percent of optimum moisture content as determined by the Modified Proctor Test (ASTM D1557). The moisture content at the time of compaction should be adjusted to achieve the required compaction. If, due to the material gradation, the Modified Proctor Test is not applicable, then compact the material to at least 75 percent relative density as determined by ASTM D4253 and D4254.

Fill material used behind foundations and/or in areas which are not beneath structural elements should be compacted to at least 90 percent of the maximum dry density at plus or minus two percent of optimum moisture content as determined by the Modified Proctor Test (ASTM D1557). The moisture content at the time of compaction should be adjusted to achieve the required compaction. If, due to the material gradation, the Modified Proctor Test is not applicable, then compact the material to at least 70 percent relative density as determined by ASTM D4253 and D4254.

The maximum particle size placed in any loose lift should be smaller than half the lift thickness. In no case should the lifts exceed eight (8) inches in loose thickness.

GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

All excavations should be completed in accordance with OSHA and any other applicable standards.

3.3.4 Suitability of Existing Site Soils

The existing fill that overlays the Site may be reused, if properly processed to remove objectionable material, reduce oversized particles, and improve its consistency. The processing should include breaking, crushing and screening oversize particles to produced individual pieces that are no more than 4 inches in their largest dimension. The fill should be placed in horizontal loose lifts of no more than 8 inches in thickness. Each lift should be compacted to at least 95 percent of the optimum dry density as determined by the Modified Proctor Test. If, due to the material gradation, the Modified Proctor Test is not applicable, then compact the material to at least 75 percent relative density as determined by ASTM D4253 and D4254.

Fill material may that is not processed to remove objectionable material and reduce oversized particles (4 inches in their largest dimension) may be used in areas in noncritical zones of fills as determined by the Geotechnical Engineer.

3.4 DRAINAGE CONSIDERATIONS

Seasonal high or perched groundwater may be encountered during site grading and/or foundation excavation for building, paved areas, utilities and other structures, thus dewatering (pumping of seepage) may be necessary. If encountered, drain seepage away from the Site by pumping from sumps at the bottom of excavations. Groundwater springs or seeps encountered during construction should be mitigated with suitable drains to intercept and minimize the potential for long-term increased phreatic surface conditions.

When possible, the Site should be graded so that surface water is directed away from construction areas and the proposed Structures. Water should not be allowed to stand in any area where foundations are to be constructed. All standing water and material that erodes into excavations should be removed before the placement of fill or concrete.

Springs and perched water may have an adverse effect on soil and rock stability, and should not be overlooked if encountered during excavation and site grading. High groundwater and excessive seepage should be reported to the Geotechnical Engineer.

3.5 PROJECT REPRESENTATIVE

Allow Sci-Tek to maintain an active role in the Project through the construction of the new foundations. This will improve project continuity and reduce risk for all parties. A geotechnical engineer who was not involved with the subsurface exploration is less familiar with subsurface conditions for this project than Sci-Tek. Consequently, it would

GEOTECHNICAL EXPLORATION REPORT
NORTHVIEW HEIGHTS MIDRISE

be best to retain Sci-Tek during the remainder of the Project to perform the following services:

1. Review construction documents during the design phase and just prior to publication for use to check conformance with the geotechnical recommendations.
2. Provide engineering services during site preparation and foundation construction to facilitate work in accordance with geotechnical recommendations.
3. Observe the bottom of excavations to document that the recommended bearing material has been reached and that the excavations are generally clear of unsuitable material and water.
4. Observe subgrade preparation and placement of structural fill in foundation areas where applicable.

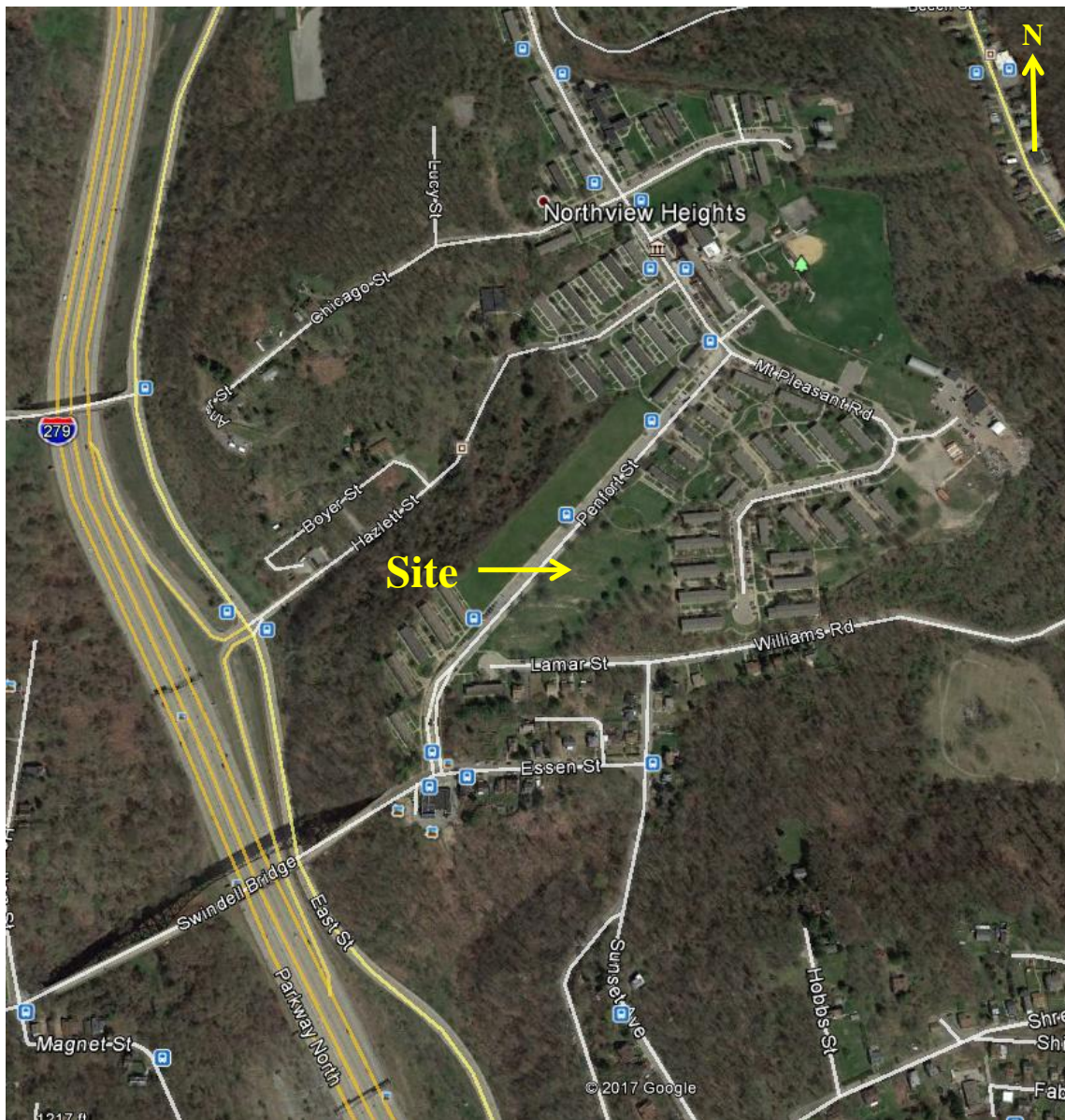
GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

4.0 Data Obtained

4.1 SITE DESCRIPTION

The Northview Heights property is located approximately 2.5 miles north of downtown Pittsburgh and less than ½ mile east on Interstate 279. The Site Vicinity Map below shows the multi-family apartment dwellings, the high-rise building, and other features of Northview Heights. The Midrise Building Site will occupy the vacant land along east side of Penfort Street.

SITE VICINITY MAP



GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

The Project Location Map below shows an enlarged view of the site.

PROJECT LOCATION MAP



The site slopes gently (5 to 7 percent), but irregularly from north to south. The existing grade and the north end of the site is approximately 1168 feet. To the south, the grade varies from 1141 feet to 1150 feet. Below the eastern portion of the south side of the site is a wooded, steep, and undeveloped hillside. The slope of this hillside is approximately 50 percent. The western portion of the south side of the Site transitions gradually to Lamar Street. The Site is covered with grass and appears to be mowed periodically. There are number of large trees scattered throughout the Site. An overhead power line that services the Northview Heights bisects the Site from the southwest to the northeast.

4.2 SUBSURFACE EXPLORATION

Geo-Environmental Drilling Company, Inc. of Pittsburgh, Pennsylvania performed the drilling for this Project as a subcontractor to Sci-Tek. The drilling was performed from May 23, 2017 through May 31, 2017. The test borings were sampled using an Diedrich and CME-55 track-mounted drill rig and hollow stem augers. Split-spoon sampling was used to obtain soil samples while rock samples were obtained with a diamond-tipped NX core barrel.

GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

The subsurface exploration included ten (10) standard test borings. The location of the testing borings is shown on the two test boring plans included in Appendix A of this report. Test Boring Location Plan A shows the location of the borings relative to the existing site conditions. Test Boring Location Plan B shows the existing and proposed grading and the location of the proposed Midrise building, parking lot, and other features relative to the borings. The depth, thickness, and type of soil encountered at the test borings are reported on the Test Boring Logs in Appendix B. The laboratory results are provided in Appendix C, of this report.

The following TABLE 4-1 summarizes the approximate ground surface elevations and termination depths of each test boring.

TABLE 4-1: TEST BORING SUMMARY

Boring No.	Approximate Ground Surface Elevation (ft)	Termination Elevation (ft)	Boring Depth (ft)
NV-1	1125.1	1106.15	19.0
NV-2	1149.9	1108.9	41.0
NV-3	1158.3	1122.3	36.0
NV-4	1161.6	1140.6	21.0
NV-6B	1163.4	1151.4	12.0
NV-7A	1164.9	1149.9	15.0
NV-8	1149.4	1129.1	20.3
NV-9	1151.8	1144.5	7.3
NV-9A	1151.3	1136.9	14.4
NV-10	1160.6	1148.4	12.2

Standard Penetration Tests: Standard Penetration Test (SPT) results were obtained in the borings. The SPT is performed by using a 140-lb. hammer dropping 30 inches to drive a 2-inch O.D. split-spoon soil sampler 18 inches into the soil. Hammer blows are counted and recorded for each 6-inch interval. The SPT test result or “N value” is the sum of blow counts for the last 12 inches of penetration.

SPT results provide a basis for foundation analysis and design, which includes a measure of soil shear strength and consistency for cohesive soils or relative density for cohesionless soils. The split-spoon samples collected during SPT tests also provide disturbed samples of the soil, which are used to visually describe the material sampled and for various laboratory tests. The results of the SPT are reported on the Boring Logs included in Appendix B of this report.

GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

4.3 TOPSOIL AND FILL CONDITIONS

The Site is overlaid by varying amounts of topsoil. In the area where the apartment dwellings were demolished, the topsoil ranged in thickness from 2 to 3 inches. In the lawn areas toward the north portion of the Site (test borings NV-6A and NV-7A) topsoil was present in the samples to a depth of 1.6 feet and 1.3 feet, respectively. No topsoil was present at test boring NV-1, which is located near the toe of the hillside beyond the developed area of Northview Heights.

Beneath the topsoil is a layer of fill. The fill was observed in all the test borings except NV-1. Test boring NV-1, which is located near the toe of the hillside beyond the developed area of Northview Heights. In general, the fill varied in thickness from approximately 3 to 12 feet.

The fill consisted of varying amount of rock fragments and sand size particles. In addition, there was varying lesser amounts of silt and clay in the fill. In addition, the fill contained debris including, but not limited to, brick, concrete block, "redog" (burned coal refuse) and wood. We saw no evidence of what would be considered discarded interior building materials, such as dry wall, wiring, plumbing, or mechanical systems.

Based on blow counts and visual observations, the fill in the areas outside the building apartment dwelling footprint appeared to show some evidence of compaction. The fill inside the footprint of the former dwellings and outside where underground utilities are shown on record drawings showed no apparent evidenced of compaction. Structures, other proposed features, and additional fill should not be constructed on or placed upon the uncompacted fill observed at the Site.

4.4 SOIL CONDITIONS

Lying beneath the fill was residual soil, except in NV-1 where no fill was encountered, and NV-9 and NV-10 which was terminated in the fill due to an obstruction. The residual soil extended to depth of 9 feet to over 20 feet below the existing ground surface.

The residual soil consisted of weathered rock fragments. The residual soil was very stiff to very hard rock fragments. Residual soil is derived from the in-situ chemical weathering of rock, so its composition will vary depending on the degree of weathering and the type of parent rock from which it originates. Although the residual soils encountered in the test borings still exhibit traces of the structure of the rock from which they came, they are technically soils for engineering purposes.

Residual soils will generally provide better support for shallow foundations than some other types of soil.

GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

4.5 BEDROCK CONDITIONS

Bedrock was drilled in four of the test borings (NV-1, NV-2, NV-3 and NV-4). The bedrock underlying the residual soil of area of the proposed Midrise Building consisted of limestone. This limestone layer was observed in test boring NV-2, NV-3 and NV-4. The limestone was very soft to hard. Much of the limestone rock core recovered was weathered. In all three borings, recovery of rock was low and in some instances the rock core was not recovered. In our opinion the limestone is highly erodible when exposed to water which was used to cool the diamond core bit while advancing the boring.

Lying beneath the limestone was layers of siltstone, sandstone and claystone.

For the complete material descriptions of the rock, see the test boring logs provided in Appendix B.

4.6 GROUNDWATER AND SURFACE WATER CONDITIONS

Groundwater level readings were immediately after completing each boring and at least 24 hours after completion. These groundwater level readings are provided on the test boring logs included in Appendix B.

In general, groundwater was not encountered in the fill while advancing the test borings. The exception, was in one test pits where water was observed at the base of the fill. It appeared that the water was trapped above the less permeable underlying residual soil.

As test borings were advanced into the residual soil, groundwater was typically encountered at the soil/rock interface. In the borings, where rock was cored the groundwater level after 24 hours varied. In test borings NV-1 and NV-4 the groundwater level was above the soil/rock interface, while in test boring NV-2 and NV-3, the groundwater level was above the soil/rock interface.

While the test drilling was being performed it rained during portions of three days. Based on our observations most of the rain infiltrated into the grass covered areas of the site. Where the earth had been disturbed from test pit activities, water did pond briefly in the uneven ground surface.

4.7 LABORATORY TESTING

Laboratory testing was conducted to estimate material engineering properties of the fill and soil encountered in the test borings. Soil classification laboratory tests were performed which included sieve analysis, hydrometer, Atterberg Limits, USCS soil classification, and water content.

Soil Classification: Several split-spoon soil samples were tested for soil classification based on their grain size distribution and Atterberg Limits. The

GEOTECHNICAL EXPLORATION REPORT NORTHVIEW HEIGHTS MIDRISE

results of these laboratory tests are included in Appendix D of this report, and are summarized in Tables 4-2, 4-3 and 4-4 below. Soil classifications are useful for identifying and comparing soil types from one location to another, and aid in selecting engineering properties for each soil type.

Moisture Content: Several split-spoon soil samples were tested for moisture content according to standard test method ASTM D2216. The results of these tests are included in Appendix D of this report, and are summarized in TABLE 4-3 below.

TABLE 4-2: SUMMARY OF SOIL CLASSIFICATION TEST RESULTS

Boring No.	Sample No.	Sample Depth (ft)		USCS Symbol	USCS Description	USDA Classification
		top	bottom			
NV-4	S-4	4.5	6.0	SM	Silty Sand (non-plastic fines)	Sandy Loam
NV-9A	S-6	7.5	9.0	CL	Lean Clay	Silty Clay
NV-2	S-6	7.5	9.0	CL	Lean Clay with Sand	Clay Loam
NV-3	S-3	3.0	4.5	SC	Clayey Sand	Loam
NV-4	S-3	3.0	4.5	ML	Sandy Silt	Loam

TABLE 4-3: SUMMARY OF MOISTURE CONTENT

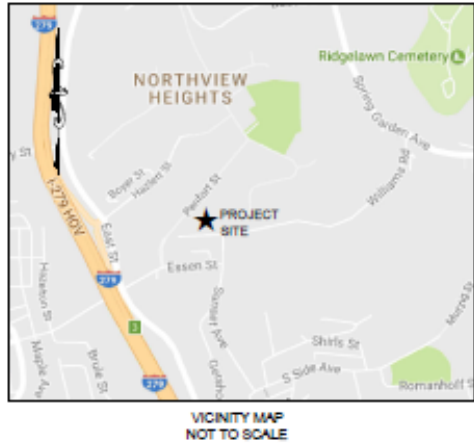
Boring No.	Sample No.	Sample Depth (ft)		Moisture Content (%)
		top	bottom	
NV-4	S-4	4.5	6.0	2.0
NV-9A	S-6	7.5	9.0	5.9
NV-2	S-6	7.5	9.0	18.2
NV-3	S-3	3.0	4.5	7.7
NV-4	S-3	3.0	4.5	7.0

GEOTECHNICAL EXPLORATION REPORT
NORTHVIEW HEIGHTS MIDRISE

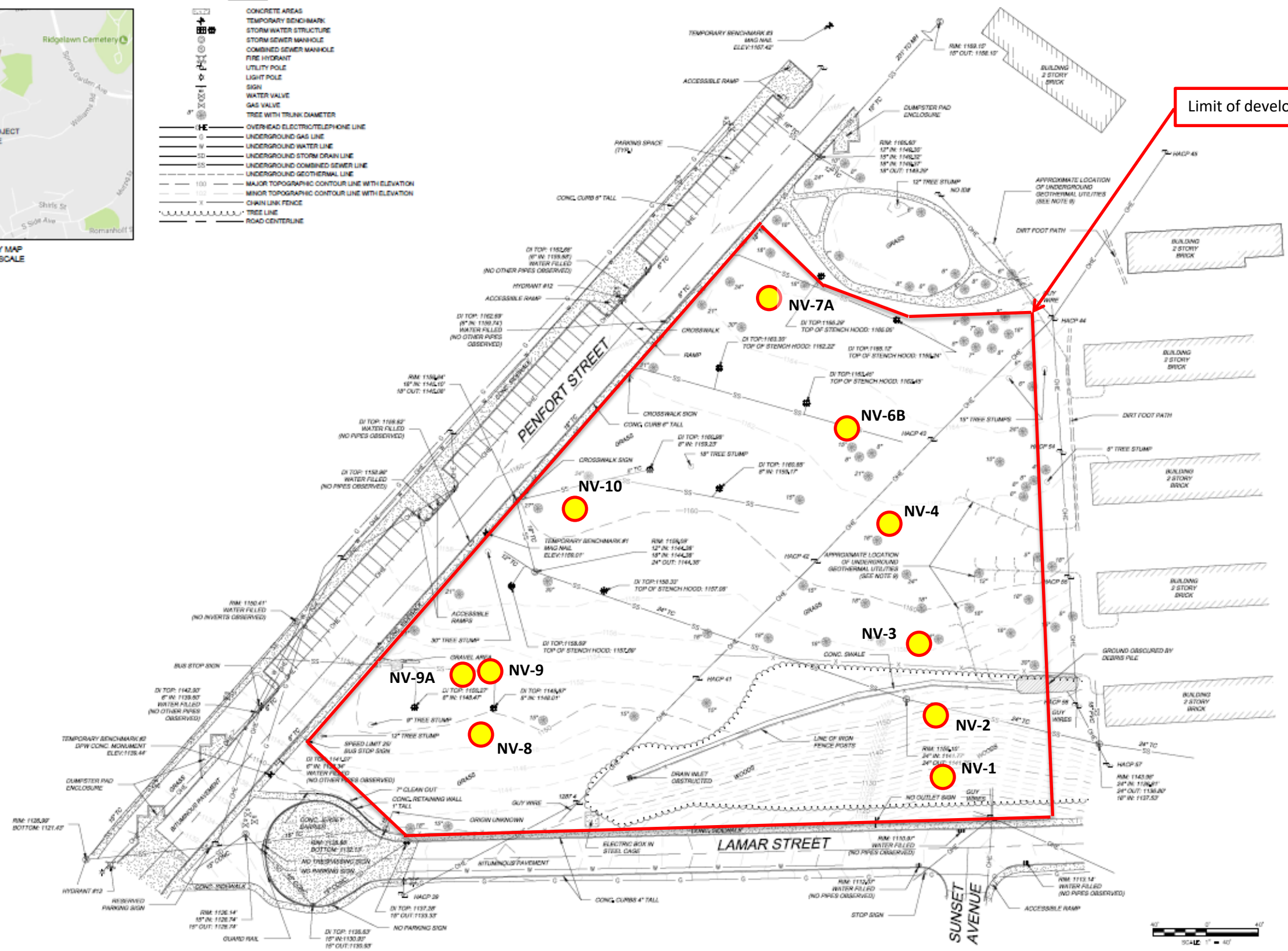
TABLE 4-4: SUMMARY OF ATTERBERG LIMITS

Boring No.	Sample No.	Sample Depth (ft)		Atterberg Limits			
		top	bottom	LL	PL	PI	USCS
NV-4	S-4	4.5	6.0	Non-plastic			SM
NV-9A	S-6	7.5	9.0	35	19	16	CL
NV-2	S-6	7.5	9.0	39	23	16	CL
NV-3	S-3	3.0	4.5	32	22	10	SC
NV-4	S-3	3.0	4.5	Non-plastic			ML

APPENDIX A TEST BORING LOCATION PLAN



- LEGEND:**
- CONCRETE AREAS
 - TEMPORARY BENCHMARK
 - STORM WATER STRUCTURE
 - STORM SEWER MANHOLE
 - COMBINED SEWER MANHOLE
 - FIRE HYDRANT
 - UTILITY POLE
 - LIGHT POLE
 - SIGN
 - WATER VALVE
 - GAS VALVE
 - TREE WITH TRUNK DIAMETER
 - OVERHEAD ELECTROTELEPHONE LINE
 - UNDERGROUND GAS LINE
 - UNDERGROUND WATER LINE
 - UNDERGROUND STORM DRAIN LINE
 - UNDERGROUND COMBINED SEWER LINE
 - UNDERGROUND GEOTHERMAL LINE
 - MAJOR TOPOGRAPHIC CONTOUR LINE WITH ELEVATION
 - MINOR TOPOGRAPHIC CONTOUR LINE WITH ELEVATION
 - CHAIN LINK FENCE
 - TREE LINE
 - ROAD CENTERLINE



LEGEND

NV-1 = Test Boring

655 Rodi Road, Suite 303 Pittsburgh, PA 15235 P: 412-371-4460 F: 412-371-4462	TEST BORING LOCATION PLAN "A" Northview Heights Midrise		Proj. No.: 17-781
	Rothschild Doyno Collaborative Pittsburgh, Pennsylvania		Scale: N.T.S.
			Date: 9/26/2017
			DWN By: EPV CHK By: GVB



<p>655 Rodi Road, Suite 303 Pittsburgh, PA 15235 P: 412-371-4460 F: 412-371-4462</p>	TEST BORING LOCATION PLAN "B" Northview Heights Midrise	Proj. No.: 17-781 Scale: N.T.S.
	Rothschild Doyno Collaborative Pittsburgh, Pennsylvania	Date: 9/26/2017 DWN By: EPV CHK By: GVB

APPENDIX B

TEST BORING LOGS

INSPECTOR'S FIELD LOG

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-23-17 ENDED 05-23-17 GROUTED Backfill/Grouted

LAT. N40°28'27.5" LONG. W80°00'02.1" NORTHING N423,613.7 EASTING E1,342,427.5

SR — SEC — SEG/OFFSET — STA — OFFSET CL/BL —

DRILLER NAME/COMPANY Gco Environmental Drilling RIG Diedrich HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD NX Core CASING TYPE/SIZE n.a. n.a. DEPTH n.a. FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY —

WATER: INITIAL DEPTH 5.9 Ft. DATE/TIME 05-23-17 PM NR ☐

FINAL DEPTH 6.9 Ft. DATE/TIME 05-24-17 AM NR ☐

BORING NO.: NV-1

SHEET 1 OF 1

ECMS #: —

O.G.ELEV. 1125.1

INSPECTOR (SIGNATURE):

Edward P. Tully

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO	USCS	GENERAL BORING REMARKS:
						Visual		MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S1	3 ₄ 13	1.4	—	1.5	A-4	ML	0.0'-1.3' Stiff, brown, clayey Silt, little sand, rock fragments, damp (residual)
3.0	S2	19 ₂₀ 31	1.5	—	4.0	A-1-b	GM-GC	1.3'-9.0'
4.5	S3	22 _{50/5}	1.0	—	1.0	A-1-b	GM-GC	Hard, light gray and light brown, Rock Fragments, dry
6.0	S4	39 _{50/5}	1.0	—	4.0	A-1-b	GM-GC	• Rock fragments are sandy shale (residual)
7.5	S5	20 _{50/5}	1.0	—	1.2	A-1-b	GM-GC	
9.0	S6	4 _{50/4}	0.7	—	4.0	A-1-b	GM-GC	Auger Refusal/Top of Rock at 9.0 feet
								9.0'-9.8' Lt Gray Sandstone, broken, v. hard
14.0	R1	—	1.4	0.7	—	—	—	9.8'-16.8'
								Gray, Clay shale, very broken, very soft
								• weathered
								• iron stained
								• lost core from barrel 9.0' to 14.0'
19.0	R2	—	5.0	1.5	—	—	—	16.8'-19.0'
								Gray, Sandstone, very broken to broken, thinly laminated, soft to medium hard
								Boring terminated at a depth of 19.0 feet

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NV-2

SHEET 1 OF 2

ECMS #:

O.G.ELEV. 1149.9

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-23-17 ENDED 05-25-17 GROUTED Backfill/Grouted

LAT. N40°28'28.0" LONG. W80°00'02.1" NORTHING N423,668.1 EASTING E1,342,444.9

SR — SEC — SEG/OFFSET — STA — OFFSET CL/BL —

DRILLER NAME/COMPANY GeoEnvironmental Drilling RIG Diedrich HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD NX Core CASING TYPE/SIZE n.a. n.a. DEPTH n.a. FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY —

WATER: INITIAL DEPTH 34.0 Ft. DATE/TIME 05-25-17 am NR ☐

FINAL DEPTH 34.0 Ft. DATE/TIME 05-26-17 am NR ☐

INSPECTOR (SIGNATURE):

Edward P. Vesely

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO		GENERAL BORING REMARKS:
						Visual	USCS	
1.5	S1	3 35	1.4	—	1.5	A-4	SM	0.0'-3.0' Loose, dark brown, silty Sand, some rock fragments, damp (fill) Topsoil 0.0'-0.7'
3.0	S2	5 45	0.5	—	0.75	A-4	SM	
4.5	S3	3 43	1.2	—	2.0	A-4	SM	3.0'-12.2' Medium stiff to very stiff, medium brown to grayish brown, Rock Fragments, some sand, some silt, moist (fill) • Trace organics, wood, coal, reddog
6.0	S4	4 55	1.2	—	2.5	A-4	SM	
7.5	S5	3 45	0.8	—	1.5	A-4	SM	
9.0	S6	3 33	1.4	—	2.0	A-4	SM	
10.5	S7	4 117	1.5	—	1.25	A-4	SM	
12.0	S8	6 1521	1.2	—	3.25	A-4	SM	
13.5	S9	4 3134	1.4	—	4.0	A-4	GP	12.0'-20.5' Hard, light gray, medium gray and brown clay shale Rock Fragments dry (residual) • Iron stained 18.5'-19.5'
15.0	S10	12 3033	1.5	—	1.25	A-4	SM	
16.5	S11	12 3450/4	1.5	—	1.75	A-4	SM	
18.0	S12	26 50/5	1.5	—	4.0	A-4	GP	
19.5	S13	30 3440	1.5	—	1.5	A-4	SM	
		9						

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NV-2 SHEET 2 OF 2

SR — SEC — STA/OFFSET — DISTRICT 11.0 COUNTY Allegheny

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO / USCS		MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
						Visual	USCS	
20.5	S14	28 59.1					SM	Top of Rock @ 20.5 feet - Auger Refusal
	R1	—	2.4	0.0	—	—	—	Gray, Limestone, very broken to broken, very soft to medium hard • Hole collapsed on Run #2 • Augered 26.5-29.0 after the hole collapsed
26.5	R2	—	0.0	0.0	—	—	—	
29.0	R3	—	0.8	0.0	—	—	—	
3.0	R4	—	5.4	0.5	—	—	—	
40.0								Boring terminated at a depth of 4.0 ft.

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NV-3

SHEET 1 OF 2

ECMS #: —

O.G.ELEV. 1158.3

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-25-17 ENDED 05-25-17 GROUTED Backfill/Plug

LAT. N40°28'28.5" LONG. W80°00'02.3" NORTHING N423,723.0 EASTING E1,342,434.5

SR — SEC — SEG/OFFSET — STA — OFFSET CL/BL —

DRILLER NAME/COMPANY Geo Environmental Drilling RIG CME-SS HOLE TYPE Split-Spoon / Auger

ROCK CORE METHOD Nx Core CASING TYPE/SIZE n.a. n.a. DEPTH — FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY —

WATER: INITIAL DEPTH 12.94 Ft. DATE/TIME 05-25-17 NR ☐

FINAL DEPTH 13.05 Ft. DATE/TIME 05-30-17 NR ☐

INSPECTOR (SIGNATURE):

Edward P. Desaly

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO USCS	GENERAL BORING REMARKS:
							MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S1	33 _C	1.5	—	4.0	A-4 SM	0.0-5.4 Loose to dense, light brown, silty sand, some rock fragments, trace clay, damp (fill)
3.0	S2	68 ₁₀	1.5	—	4.0	A-4 SM	
4.5	S3	1214 ₁₉	1.5	—	0.25	A-4 SM	
6.0	S4	727 ₄₅	1.5	—	0.0	A-1-b GP	
7.5	S5	1822 ₆	1.5	—	0.0	A-4 SM	5.4-11.2 Medium stiff to hard, light gray, Rock Fragments, trace silt (redisual)
9.0	S6	817 ₁₁	1.5	—	0.0	A-4 SM	
10.5	S7	243	0.6	—	2.75	A-4 SM	
12.0	S8	50 ₁₃	0.3	—	0.0	A-1-b GP	Top of Rock 11.2 feet
16.0	R1	—	3.0	1.7	—	—	11.0 to 35.3 feet Medium gray, Limestone, very broken to blocky, very soft to hard
	R2	—	2.7	0.7	—	—	Continued on Sheet 2

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NV-3 SHEET 2 OF 2

SR SEC STA/OFFSET DISTRICT 11.0 COUNTY Allegheny

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO		MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
						Visual	USCS	
26.0								Continued from Sheet 1
	R3	-	6.2	0.5	-	-		
36.0								35.3 - 41.0 feet Medium gray, Siltstone, very broken to broken, soft to hard
	R4	-	4.1	0.5	-	-		
41.0								Boring terminated at a depth of 41.0 feet

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NY-4

SHEET 1 OF 2

ECMS #:

O.G.ELEV. 1161.6

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-26-17 ENDED 05-26-17 GROUTED Backfill/Plug

LAT. N 40° 28' 29.4" LONG. W 80° 00' 02.6" NORTHING N 423,818.0 EASTING E 1,342,412.5

SR SEC SEG/OFFSET STA OFFSET CL/BL

DRILLER NAME/COMPANY GeoEnvironmental Drilling RIG CME-SS HOLE TYPE Split-Spoon/Auger

ROCK CORE METHOD NX Core CASING TYPE/SIZE n.a. n.a. DEPTH FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY

WATER: INITIAL DEPTH 13.95 Ft. DATE/TIME 05-26-17 pm NR ☐

FINAL DEPTH 5.90 Ft. DATE/TIME 05-30-17 am NR ☐

INSPECTOR (SIGNATURE):

Edward P. Vesely

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO USCS	GENERAL BORING REMARKS:
						Visual	MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S1	5	1.5	-	1.0	A-1-b GM	0.0 - 4.4 feet Medium Dense, dark gray and brown, Sand and Rock Fragments, little silt, trace clay, moist (residual)
3.0	S2	11	1.1	-	2.0	A-1-b GP	
4.5	S3	4	1.3	-	-	A-4 SM	
6.0	S4	43	0.7	-	0.0	A-1-b GP	4.4 - 12.0 feet Hard, light gray, Rock Fragments, trace silt, dry (residual)
7.5	S5	50/5	0.2	-	0.0	A-1-b GP	
9.0	S6	50/5	0	-	No Rec.	-	
10.5	S7	50/6	0.4	-	0.5	A-4 SM	Auger Refusal at 12.0 feet Medium gray, Limestone, very broken to broken, very soft to hard
12.0	S8	17	0.8	-	0.0	A-1-b GP	
	RI	-	9.0	0.0	-	-	
							Continued on Sheet 2 of 2

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES



BORING NO.: NV-4 SHEET 2 OF 2

SR SEC STA/OFFSET DISTRICT 11.0 COUNTY Allegheny

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO / USCS		MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
						Visual		
21.0								Continued from Sheet 1
								Boring terminated at a depth of 21.0 feet

INSPECTOR'S FIELD LOG

BORING NO.: NY-68

SHEET 1 OF 1

ECMS #:

O.G.ELEV. 1163.4

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-26-17 ENDED 05-26-17 GROUTED Backfill/Plug

LAT. N40°28'30.2" LONG. W80°00'02.9" NORTHING N423.889.8 EASTING 1,342,388.5

SR SEC SEG/OFFSET STA OFFSET CL/BL

DRILLER NAME/COMPANY Geo Environmental Drilling RIG CME-SS HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD Not applicable CASING TYPE/SIZE n.a. n.a. DEPTH FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY

WATER: INITIAL DEPTH Dry Ft. DATE/TIME 05-26-17 NR ☐

FINAL DEPTH Dry Ft. DATE/TIME 05-30-17 NR ☐

INSPECTOR (SIGNATURE):

Edward P. Dwyer

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO USCS	GENERAL BORING REMARKS:
						Visual	MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S1	1 6	1.5	-	0.25	A-4 SM	0.0-2.3 feet Loose, brown and gray, ROCK FRAGMENTS and SAND, trace silt, trace clay, moist (fill)
3.0	S2	7 14 48	1.5	-	3.25 0.0	A-1-b GM	
4.5	S3	30 50/5	0.8	-	0.0	A-1-b GP	2.3-12.0 feet Hard, light brown and light gray, ROCK FRAGMENTS, trace silt, dry (residual)
6.0	S4	7 50/5	0.6	-	0.0	A-1-b GP	
7.5	S5	50/5	0.5	-	0.0	A-1-b GP	
9.0	S6	50/4	0.4	-	0.0	A-1-b GP	
10.5	S7	50/4	0.4	-	0.0	A-1-b GP	
12.0	S8	28 50/4	0.8	-	0.0	A-1-b GM	Auger Refusal at 12.0 feet
							Bottom of Boring 12.0 feet

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NY-7A

SHEET 1 OF 1

ECMS #:

O.G.ELEV. 1164.9

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-30-17 ENDED 05-30-17 GROUTED Backfill/Plug

LAT. N40°28'31.1" LONG. W80°00'03.9" NORTHING N423,987.4 EASTING E1,342,317.2

SR SEC SEG/OFFSET STA OFFSET CL/BL

DRILLER NAME/COMPANY Geo Environmental Drilling RIG CME-55 HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD Not applicable CASING TYPE/SIZE n.a. n.a. DEPTH FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY

WATER: INITIAL DEPTH dry Ft. DATE/TIME 05-31-17 NR ☐

FINAL DEPTH dry Ft. DATE/TIME 05-31-17 NR ☐

INSPECTOR (SIGNATURE):

Edward P. Truly

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO USCS	GENERAL BORING REMARKS:
							MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S1	6 10 5	1.0	-	1.25	A-4 SM	0.0-6.0 feet Loose to medium dense, brown and gray Rock Fragments and Sand little silt, trace clay, moist (f.11) Organics 0.0-1.3 feet
3.0	S2	4 4 10	1.1	-	1.0	A-1-b GP	
4.5	S3	7 3 4	0.5	-	0.0	A-1-b GP	
6.0	S4	3 1 3	0.4	-	0.0	A-1-b GP	
7.5	S5	50/4	0.4	-	1.75	A-1-b GM	6.0-15.0 Very stiff to hard, light gray Rock Fragments, trace silt, dry (residual) • Outside of Split Spoon - wet - 13.5-15.0'
9.0	S6	50/5	0.5	-	0.0	A-1-b GP	
10.5	S7	23 37 37	1.5	-	0.0	A-1-b GP	
12.0	S8	20 31 41	1.4	-	3.25	A-1-b GP	
13.5	S9	7 50/4	0.7	-	0.0	A-1-b GP	
15.0	S10	9 7 10	1.3	-	1.75	A-1-b GP	
							Bottom of Boring @ 15.0 feet

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

INSPECTOR'S FIELD LOG

BORING NO.: NV-8

SHEET 1 OF 2

ECMS #:

O.G.ELEV. 1149.4

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-30-17 ENDED 05-30-17 GROUTED Backfill/Plug

LAT. N40°26'27.7" LONG. W80°00'06.6" NORTHING N423,653.9 EASTING E1,342,096.6

SR SEC SEG/OFFSET STA OFFSET CL/BL

DRILLER NAME/COMPANY GeoEnvironmental Drilling RIG CME-SS HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD Not applicable CASING TYPE/SIZE n.a. n.a. DEPTH FT.

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY

WATER: INITIAL DEPTH 17.38 Ft. DATE/TIME 05-30-17 NR ☐

FINAL DEPTH 8.29 Ft. DATE/TIME 05-31-17 NR ☐

INSPECTOR (SIGNATURE):

Edward P. Terey

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO USCS	Visual	GENERAL BORING REMARKS:
1.5	S1	246	0.8	-	4.0	A-1-b	GP	0.0-2.3 feet Loose, brown & gray ROCK FRAGMENTS and SAND, trace silt, trace clay; moist (fill)
3.0	S2	61034	1.5	-	3.25	A-1-b	GP	
4.5	S3	63450/5	1.0	-	0.0	A-1-b	GP	2.3-20.3 feet Hard, light gray, ROCK FRAGMENTS, trace silt (dry) (residual) • iron staining 5.0'-9.0' • outside of slit spoon sample wet, 16.5-18.0'
6.0	S4	102020	1.3	-	0.0	A-1-b	GP	
7.5	S5	2950/4	1.3	-	0.0	A-1-b	GP	
9.0	S6	134650/2	1.4	-	0.0	A-1-b	GP	
10.5	S7	73650/2	1.2	-	0.0	A-1-b	GP	
12.0	S8	114150/3	1.5	-	0.0	A-1-b	GP	
13.5	S9	2350/4	0.9	-	0.0	A-1-b	GP	
15.0	S10	50/3	0.3	-	0.0	A-1-b	GP	
16.5	S11	50/3	0.3	-	0.0	A-1-b	GP	
18.0	S12	3750/2	0.7	-	1.0	A-1-b	GP	
19.5	S13	50/5	0.5	-	0.0	A-1-b	GP	
						A-1-b	GP	

Continued on Sheet 2 of 2

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES



BORING NO.: NV-8 SHEET 2 OF 2

SR _____ SEC _____ STA/OFFSET _____ DISTRICT 11.0 COUNTY Allegheny

[illegible]



BORING NO.: NV-9A

SHEET 1 OF 1

ECMS #:

O.G.ELEV. 1151.3

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-31-17 ENDED 05-31-17 GROUTED Backfill/Plug

LAT. N 40° 28' 28.1" LONG. W 80° 00' 06.7" NORTHING N 423,694.8 EASTING E 1,342,093.1

SR SEC SEG/OFFSET STA OFFSET CL/BL

DRILLER NAME/COMPANY GeoEnvironmental Drilling RIG CME-55 HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD	Not Applicable	CASING TYPE/SIZE	n.a.	n.a.	DEPTH	-	FT.
------------------	----------------	------------------	------	------	-------	---	-----

HAMMER: TYPE/CALIBRATION DATE not recorded n.a. EFFICIENCY -

INSPECTOR (SIGNATURE):

WATER: INITIAL DEPTH Dry Ft. DATE/TIME 05-31-17 NR ☐

Edward P. Vesper

FINAL DEPTH 1 Ft. DATE/TIME Backfilled NR ☐

CERT NO.: n.a.

3-52

INSPECTOR'S FIELD LOG

BORING NO.: NV-10

SHEET 1 OF 1

ECMS #:

O.G.ELEV. 1160.6

PROJECT NAME: Northview Heights Midrise DISTRICT 11.0 COUNTY Allegheny

DATE/TIME: STARTED 05-30-17 ENDED 05-30-17 GROUTED Backfill/Plug

LAT. N40°28'29.5" LONG. W80°00'05.8" NORTHING N423,826.6 EASTING E1,342,168.7

SR — SEC — SEG/OFFSET — STA — OFFSET CL/BL —

DRILLER NAME/COMPANY Geo Environmental Drilling RIG CME-55 HOLE TYPE Split Spoon/Auger

ROCK CORE METHOD Not applicable CASING TYPE/SIZE n.a. n.a. DEPTH — FT.

HAMMER: TYPE/CALIBRATION DATE Not recorded n.a. EFFICIENCY —

WATER: INITIAL DEPTH dry Ft. DATE/TIME 05-30-17 NR ☐

FINAL DEPTH dry Ft. DATE/TIME 05-31-17 NR ☐

INSPECTOR (SIGNATURE):

Edward P. Kelly

CERT NO.: n.a.

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO USCS	GENERAL BORING REMARKS:
						Visual	MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S-1	29 ₉	1.5	—	—	A-1-b GM-GC	0.0 - 12.2 feet Medium dense to very dense, brown and gray ROCK FRAGMENTS and SAND, trace silt, trace clay, moist (f.11) • Organics 0.0-0.3 • Wood fragments 1.5-2.0 • Brick 2.5-2.8 and 5.3-5.6 • Bent split spoon 9.0-10.5 and 10.5-11.3 • Wet 9.0-10.5
3.0	S-2	6 ₁₀ 20	1.0	—	0.0	A-1-b GM-GC	
4.5	S-3	58 ₄	0.7	—	0.0	A-1-b GM-GC	
6.0	S-4	43 ₈	1.1	—	0.0	A-1-b GM-GC	
7.5	S-5	148 ₉	1.5	—	—	A-1-b GM-GC	
9.0	S-6	50/3	0.3	—	0.0	A-1-b GM-GC	
10.5	S-7	11 ₁₂ 48	1.1	—	—	A-1-b GM-GC	
12.0	S-8	1450/3	0.8	—	—	A-1-b GM-GC	
13.5	S-9	50/2	No Rec.	—	—	N.A. N.A.	Bottom of Boring 12.2 feet

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

APPENDIX C

LABORATORY TEST REPORTS



July 17, 2017

Project No. 2017-355-001

Mr. Ed Vesely
SCI-TEK Consultants
655 Rodi Road, Suite 303
Pittsburgh, PA 15235

Transmittal
Laboratory Test Results
Northview Heights-Midrise 17-781

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens that were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

***We understand that you have a choice in your laboratory services
and we thank you for choosing Geotechnics.***

MOISTURE CONTENT

ASTM D 2216-10

Client: SCI TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001

Lab ID:	001	002	003	004	005
Boring No.:	NV-2	NV-3	NV-4	NV-4	NV-9A
Depth (ft):	7.5-9.0	3.0-4.5	3.0-4.5	4.5-6.0	7.5-9.0
Sample No.:	S-6	S-3	S-3	S-4	S-6
Tare Number	41	26	42	47	50
Wt. of Tare & Wet Sample (g)	33.73	35.10	38.71	39.53	33.78
Wt. of Tare & Dry Sample (g)	29.59	33.10	36.62	38.90	32.27
Weight of Tare (g)	6.90	6.98	6.90	6.65	6.82
Weight of Water (g)	4.14	2.00	2.09	0.63	1.51
Weight of Dry Sample (g)	22.69	26.12	29.72	32.25	25.45
Water Content (%)	18.2	7.7	7.0	2.0	5.9

Notes :

Tested By PC Date 6/29/17 Checked By TMP Date 6/30/17

page 1 of 1

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

S:\Excel\Excel Qa\Spreadsheets\Water Content.xls

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)



Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-001

Boring No.: NV-2
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Color: Dark Brown

USCS USDA	SIEVE ANALYSIS					HYDROMETER	
	cobbles	gravel		sand		silt and clay fraction	
	cobbles	gravel		sand		silt	clay

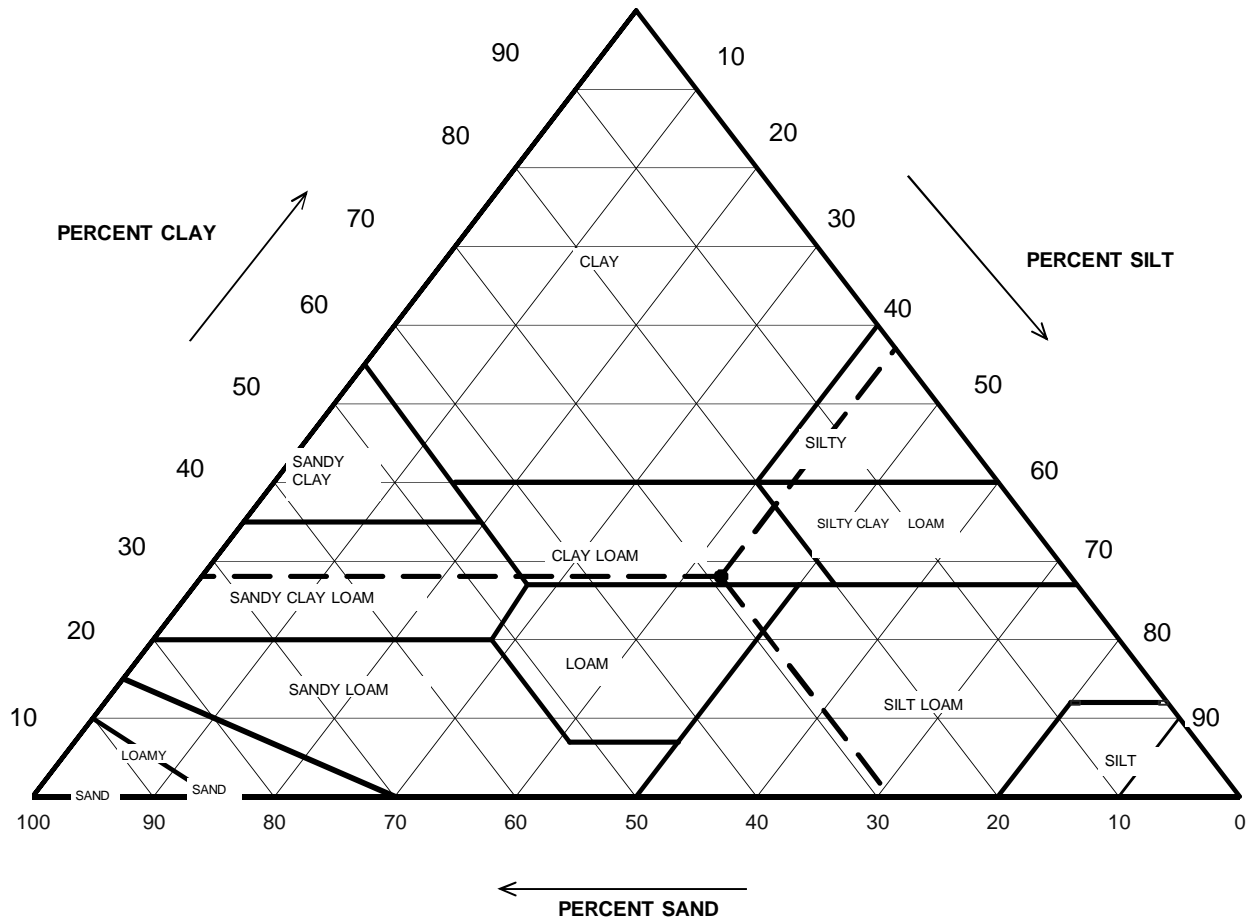


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.00
#4 To #200	Sand	25.56
Finer Than #200	Silt & Clay	74.44
USCS Symbol: <i>CL, TESTED</i>		
USCS Classification: <i>LEAN CLAY WITH SAND</i>		

USDA CLASSIFICATION CHART

Client: SCI-TEK Consultants
Client Reference: Northview Heights-Midrise 17-781
Project No.: 2017-355-001
Lab ID: 2017-355-001-001

Boring No.: NV-2
Depth (ft): 7.5-9.0
Sample No.: S-6
Soil Color: Dark Brown



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	96.41	Gravel	3.59	0.00
0.05	68.52	Sand	27.90	28.94
0.002	27.07	Silt	41.45	42.99
		Clay	27.07	28.07
		USDA Classification:	CLAY LOAM	

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-001

Boring No.: NV-2
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Color: Dark Brown

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1441	Tare No.	NA
Weight of Tare & Wet Sample (g)	303.15	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	303.15	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	143.37	Weight of Tare (g)	NA
Weight of Water (g)	0.00	Weight of Water (g)	NA
Weight of Dry Sample (g)	159.78	Weight of Dry Sample (g)	NA
Moisture Content (%)	0.0	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	159.78
Dry Weight of -3/4" Sample (g)	40.84	Weight of - #200 Material (g)	118.94
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	40.84
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	100.00
6"	150	0.00	0.00	0.00		100.00	100.00
3"	75	0.00	0.00	0.00		100.00	100.00
2"	50	0.00	0.00	0.00		100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00		100.00	100.00
1"	25.0	0.00	0.00	0.00		100.00	100.00
3/4"	19.0	0.00	0.00	0.00		100.00	100.00
1/2"	12.5	0.00	0.00	0.00		100.00	100.00
3/8"	9.50	0.00	0.00	0.00		100.00	100.00
#4	4.75	0.00	0.00	0.00		100.00	100.00
#10	2.00	5.73	3.59	3.59		96.41	96.41
#20	0.85	12.15	7.60	11.19		88.81	88.81
#40	0.425	6.60	4.13	15.32		84.68	84.68
#60	0.250	4.05	2.53	17.86		82.14	82.14
#140	0.106	7.26	4.54	22.40		77.60	77.60
#200	0.075	5.05	3.16	25.56		74.44	74.44
Pan	-	118.94	74.44	100.00		-	-

Tested By HL Date 7/13/17 Checked By TMP Date 7/17/17

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-001

Boring No.: NV-2
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Color: Dark Brown

Elapsed Time	R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)		(°C)			(%)		(mm)	(%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	38.0	23.3	5.89	32.1	81.4	0.01293	0.0290	60.6
5	35.0	23.3	5.89	29.1	73.8	0.01293	0.0188	54.9
15	31.5	23.3	5.89	25.6	64.9	0.01293	0.0111	48.3
30	28.0	23.3	5.89	22.1	56.0	0.01293	0.0081	41.7
61	25.0	23.8	5.71	19.3	48.9	0.01285	0.0057	36.4
250	21.5	24.7	5.39	16.1	40.8	0.01272	0.0029	30.4
1440	17.5	24.4	5.50	12.0	30.4	0.01276	0.0012	22.6

Soil Specimen Data		Other Corrections	
Tare No.	679		
Weight of Tare & Dry Material (g)	138.05	a - Factor	0.99
Weight of Tare (g)	93.98		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	74.44
Weight of Dry Material (g)	39.1	Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

ATTERBERG LIMITS

ASTM D 4318-10

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-001

Boring No.: NV-2
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Description: DARK BROWN LEAN CLAY

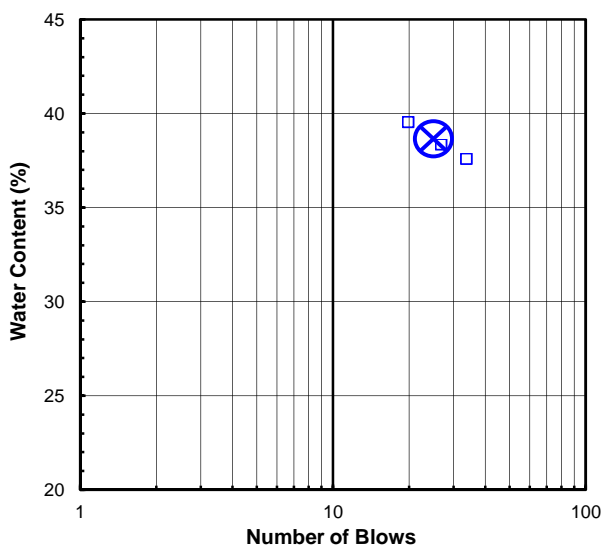
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. (Minus No. 40 sieve material, Air dried) sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	41	14	121	126	U
Wt. of Tare & Wet Sample (g):	33.73	40.73	40.01	43.60	L
Wt. of Tare & Dry Sample (g):	29.59	34.90	34.31	36.77	T
Weight of Tare (g):	6.90	19.37	19.43	19.48	I
Weight of Water (g):	4.1	5.8	5.7	6.8	P
Weight of Dry Sample (g):	22.7	15.5	14.9	17.3	O
Was As Received MC Preserved:	Yes				I
Moisture Content (%):	18.2	37.5	38.3	39.5	N
Number of Blows:		34	27	20	T

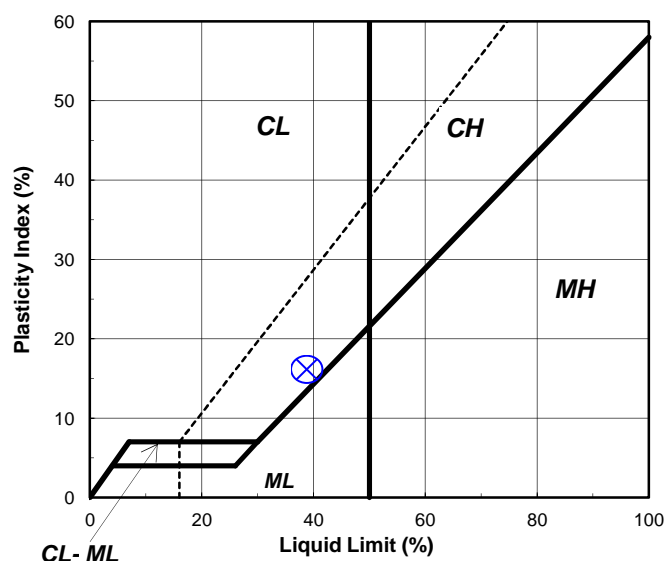
Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	131	167		Liquid Limit (%):	39
Wt. of Tare & Wet Sample (g):	25.84	24.49		Plastic Limit (%):	23
Wt. of Tare & Dry Sample (g):	24.71	23.37		Plasticity Index (%):	16
Weight of Tare (g):	19.71	18.43		USCS Symbol:	CL
Weight of Water (g):	1.1	1.1			
Weight of Dry Sample (g):	5.0	4.9			
Moisture Content (%):	22.6	22.7	-0.1		

Note: The acceptable range of the two Moisture contents is ± 1.4

Flow Curve



Plasticity Chart



Tested By BS Date 7/6/17 Checked By TMP Date 7/7/17

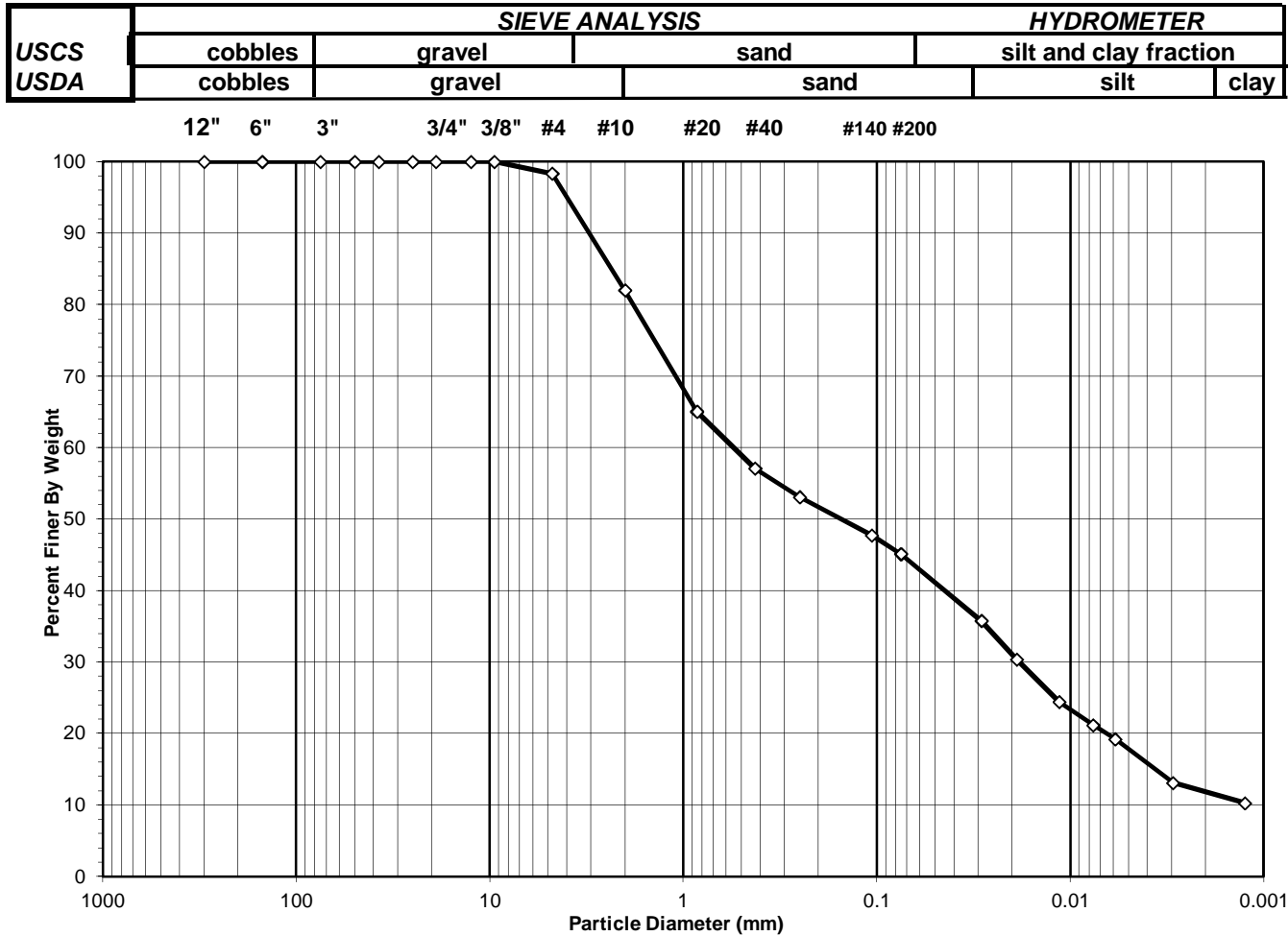
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)



Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-002

Boring No.: NV-3
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Color: Brown

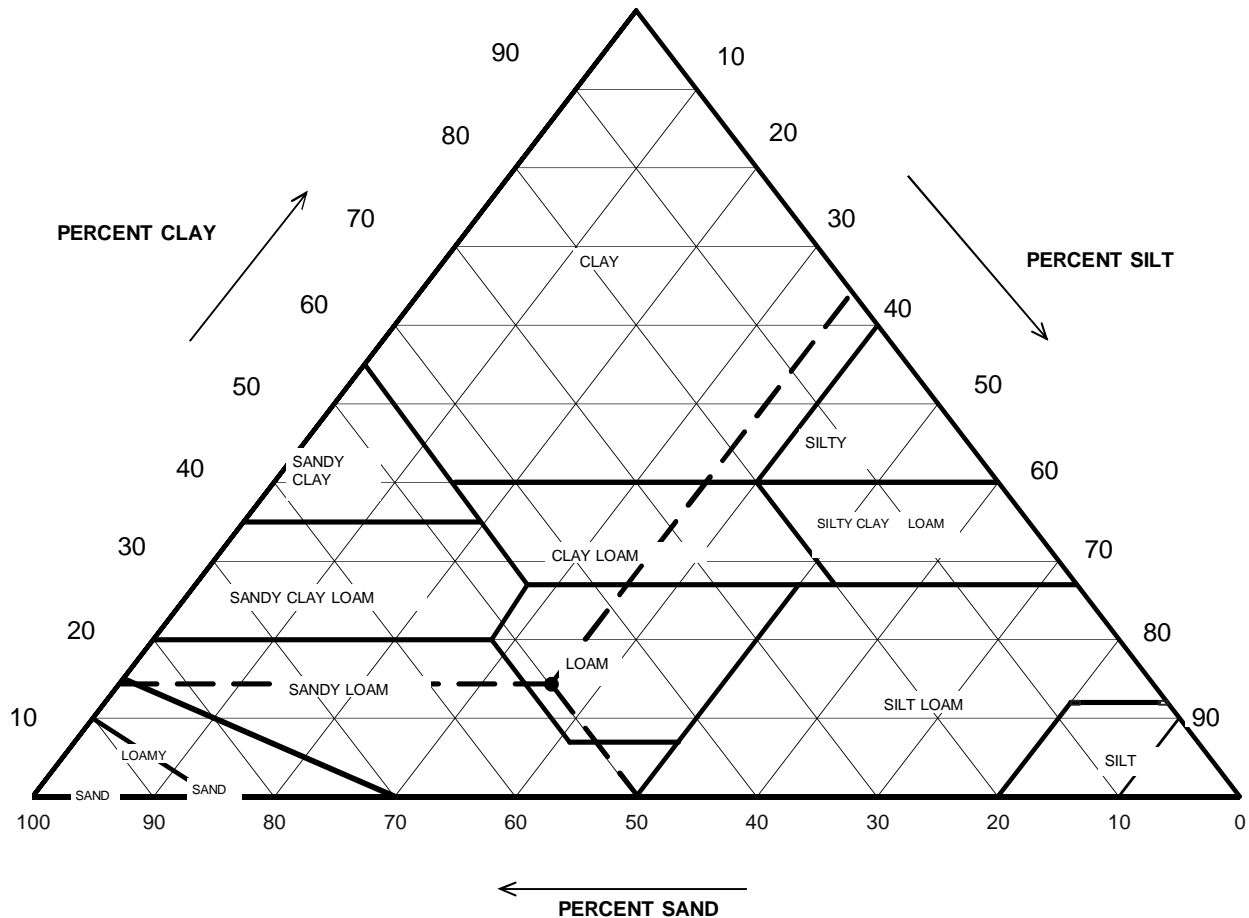


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	1.65
#4 To #200	Sand	53.25
Finer Than #200	Silt & Clay	45.10
USCS Symbol: SC, TESTED		
USCS Classification: CLAYEY SAND		

USDA CLASSIFICATION CHART

Client: SCI-TEK Consultants
Client Reference: Northview Heights-Midrise 17-781
Project No.: 2017-355-001
Lab ID: 2017-355-001-002

Boring No.: NV-3
Depth (ft): 3.0-4.5
Sample No.: S-3
Soil Color: Brown



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	82.01	Gravel	17.99	0.00
0.05	41.13	Sand	40.88	49.85
0.002	11.80	Silt	29.33	35.77
		Clay	11.80	14.39
		USDA Classification:	LOAM	

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-002

Boring No.: NV-3
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Color: Brown

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1511	Tare No.	NA
Weight of Tare & Wet Sample (g)	353.24	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	353.24	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	147.57	Weight of Tare (g)	NA
Weight of Water (g)	0.00	Weight of Water (g)	NA
Weight of Dry Sample (g)	205.67	Weight of Dry Sample (g)	NA
Moisture Content (%)	0.0	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	205.67
Dry Weight of -3/4" Sample (g)	112.91	Weight of - #200 Material (g)	92.76
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	112.91
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	100.00
6"	150	0.00	0.00	0.00		100.00	100.00
3"	75	0.00	0.00	0.00		100.00	100.00
2"	50	0.00	0.00	0.00		100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00		100.00	100.00
1"	25.0	0.00	0.00	0.00		100.00	100.00
3/4"	19.0	0.00	0.00	0.00		100.00	100.00
1/2"	12.5	0.00	0.00	0.00		100.00	100.00
3/8"	9.50	0.00	0.00	0.00		100.00	100.00
#4	4.75	3.40	1.65	1.65		98.35	98.35
#10	2.00	33.59	16.33	17.99		82.01	82.01
#20	0.85	34.92	16.98	34.96		65.04	65.04
#40	0.425	16.35	7.95	42.91		57.09	57.09
#60	0.250	8.25	4.01	46.92		53.08	53.08
#140	0.106	11.05	5.37	52.30		47.70	47.70
#200	0.075	5.35	2.60	54.90		45.10	45.10
Pan	-	92.76	45.10	100.00		-	-

Tested By HL Date 7/13/17 Checked By TMP Date 7/17/17

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-002

Boring No.: NV-3
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Color: Brown

Elapsed Time	R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)		(°C)			(%)		(mm)	(%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	39.0	23.3	5.89	33.1	79.3	0.01293	0.0288	35.8
5	34.0	23.3	5.89	28.1	67.3	0.01293	0.0189	30.4
15	28.5	23.3	5.89	22.6	54.1	0.01293	0.0114	24.4
35	25.5	23.3	5.89	19.6	47.0	0.01293	0.0076	21.2
60	23.5	23.8	5.71	17.8	42.6	0.01285	0.0059	19.2
250	17.5	24.7	5.39	12.1	29.0	0.01272	0.0029	13.1
1440	15.0	24.4	5.50	9.5	22.8	0.01276	0.0013	10.3

Soil Specimen Data		Other Corrections	
Tare No.	2327		
Weight of Tare & Dry Material (g)	141.32	a - Factor	0.99
Weight of Tare (g)	94.98		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	45.10
Weight of Dry Material (g)	41.3	Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

ATTERBERG LIMITS

ASTM D 4318-10

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-002

Boring No.: NV-3
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Description: BROWN LEAN CLAY

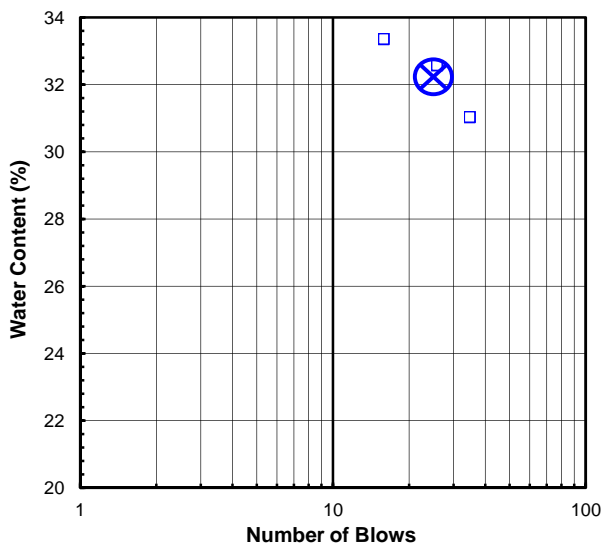
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	26	212	454	202	U
Wt. of Tare & Wet Sample (g):	35.10	39.62	35.60	37.79	L
Wt. of Tare & Dry Sample (g):	33.10	34.54	30.51	32.94	T
Weight of Tare (g):	6.98	19.30	14.87	17.30	I
Weight of Water (g):	2.0	5.1	5.1	4.9	P
Weight of Dry Sample (g):	26.1	15.2	15.6	15.6	O
Was As Received MC Preserved:	Yes				I
Moisture Content (%):	7.7	33.3	32.5	31.0	N
Number of Blows:		16	26	35	T

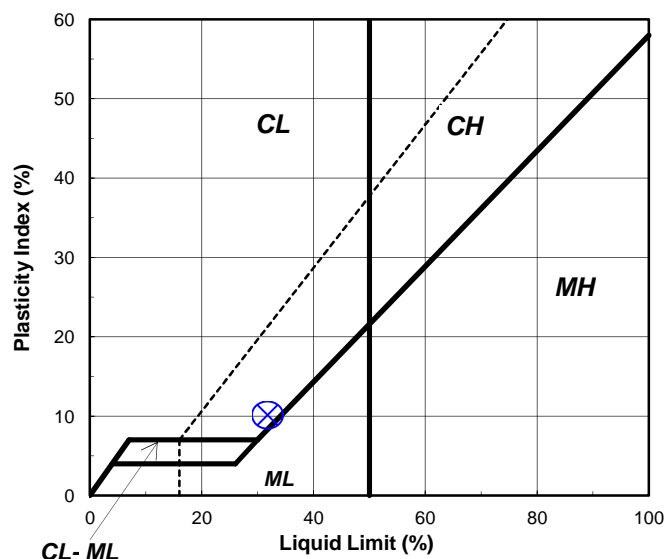
Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	179	1237		Liquid Limit (%):	32
Wt. of Tare & Wet Sample (g):	24.77	25.04		Plastic Limit (%):	22
Wt. of Tare & Dry Sample (g):	23.63	23.93		Plasticity Index (%):	10
Weight of Tare (g):	18.35	18.79		USCS Symbol:	CL
Weight of Water (g):	1.1	1.1			
Weight of Dry Sample (g):	5.3	5.1			
Moisture Content (%):	21.6	21.6	0.0		

Note: The acceptable range of the two Moisture contents is ± 1.4

Flow Curve



Plasticity Chart



Tested By RAL Date 7/7/17 Checked By KC Date 7/8/17

SIEVE AND HYDROMETER ANALYSIS

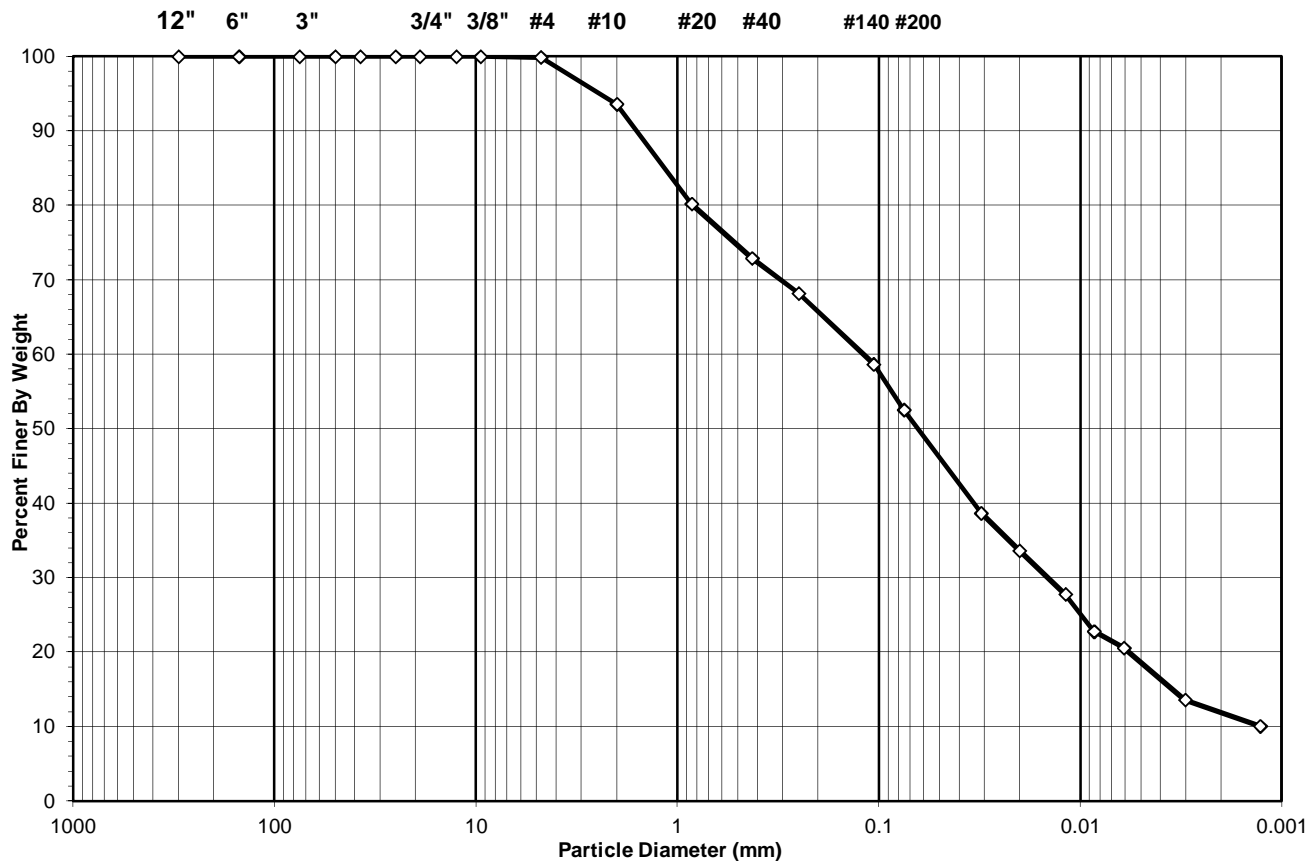
ASTM D 422-63 (2007)



Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-003

Boring No.: NV-4
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Color: Brown

USCS USDA	SIEVE ANALYSIS						HYDROMETER	
	cobbles	gravel		sand			silt and clay fraction	
	cobbles	gravel		sand			silt	clay

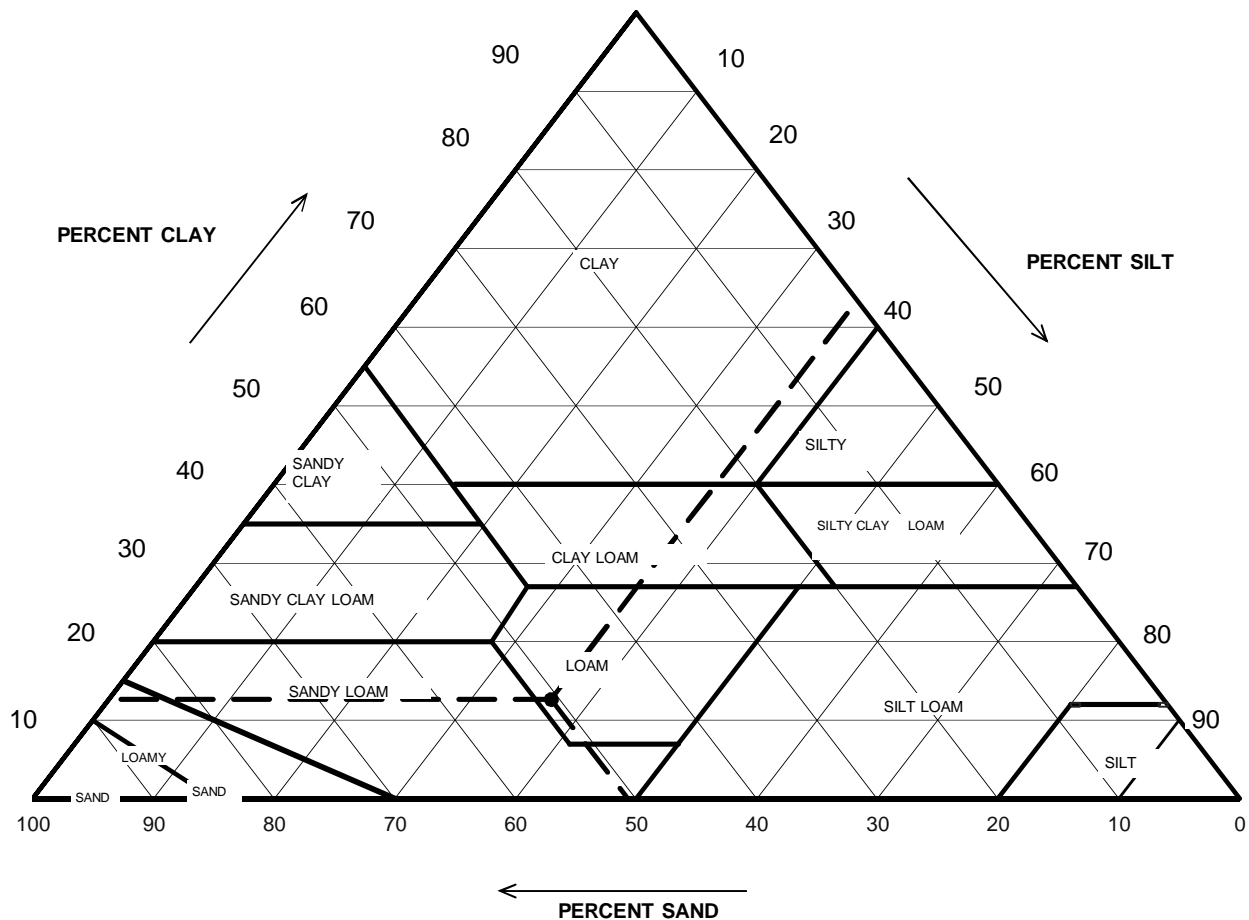


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.11
#4 To #200	Sand	47.38
Finer Than #200	Silt & Clay	52.51
USCS Symbol: <i>ML, TESTED</i>		
USCS Classification: <i>SANDY SILT</i> <i>(NON-PLASTIC FINES)</i>		

USDA CLASSIFICATION CHART

Client: SCI-TEK Consultants
Client Reference: Northview Heights-Midrise 17-781
Project No.: 2017-355-001
Lab ID: 2017-355-001-003

Boring No.: NV-4
Depth (ft): 3.0-4.5
Sample No.: S-3
Soil Color: Brown



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	93.59	Gravel	6.41	0.00
0.05	46.13	Sand	47.45	50.70
0.002	11.88	Silt	34.26	36.61
		Clay	11.88	12.69
		USDA Classification:	LOAM	

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-003

Boring No.: NV-4
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Color: Brown

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1473	Tare No.	NA
Weight of Tare & Wet Sample (g)	331.77	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	304.02	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	146.03	Weight of Tare (g)	NA
Weight of Water (g)	27.75	Weight of Water (g)	NA
Weight of Dry Sample (g)	157.99	Weight of Dry Sample (g)	NA
Moisture Content (%)	17.6	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	157.99
Dry Weight of -3/4" Sample (g)	75.03	Weight of - #200 Material (g)	82.96
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	75.03
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	100.00
6"	150	0.00	0.00	0.00		100.00	100.00
3"	75	0.00	0.00	0.00		100.00	100.00
2"	50	0.00	0.00	0.00		100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00		100.00	100.00
1"	25.0	0.00	0.00	0.00		100.00	100.00
3/4"	19.0	0.00	0.00	0.00		100.00	100.00
1/2"	12.5	0.00	0.00	0.00		100.00	100.00
3/8"	9.50	0.00	0.00	0.00		100.00	100.00
#4	4.75	0.18	0.11	0.11		99.89	99.89
#10	2.00	9.95	6.30	6.41		93.59	93.59
#20	0.85	21.18	13.41	19.82		80.18	80.18
#40	0.425	11.54	7.30	27.12		72.88	72.88
#60	0.250	7.40	4.68	31.81		68.19	68.19
#140	0.106	15.05	9.53	41.33		58.67	58.67
#200	0.075	9.73	6.16	47.49		52.51	52.51
Pan	-	82.96	52.51	100.00		-	-

Tested By HL Date 7/13/17 Checked By TMP Date 7/17/17

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-003

Boring No.: NV-4
 Depth (ft): 3.0-4.5
 Sample No.: S-3
 Soil Color: Brown

Elapsed Time	R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)		(°C)			(%)		(mm)	(%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	29.0	23.3	5.89	23.1	73.6	0.01293	0.0311	38.6
5	26.0	23.3	5.89	20.1	64.0	0.01293	0.0201	33.6
15	22.5	23.3	5.89	16.6	52.9	0.01293	0.0119	27.8
30	19.5	23.3	5.89	13.6	43.3	0.01293	0.0085	22.8
60	18.0	23.8	5.71	12.3	39.1	0.01285	0.0061	20.5
250	13.5	24.7	5.39	8.1	25.8	0.01272	0.0030	13.6
1440	11.5	24.4	5.50	6.0	19.1	0.01276	0.0013	10.0

Soil Specimen Data			Other Corrections		
Tare No.	1018				
Weight of Tare & Dry Material (g)	128.98	a - Factor		0.99	
Weight of Tare (g)	92.90				
Weight of Deflocculant (g)	5.0	Percent Finer than # 200		52.51	
Weight of Dry Material (g)	31.1	Specific Gravity		2.7	Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

ATTERBERG LIMITS

ASTM D 4318-10

Client: SCI-TEK Consultants
Client Reference: Northview Heights-Midrise 17-781
Project No.: 2017-355-001
Lab ID: 2017-355-001-003

Boring No.: NV-4
Depth (ft): 3.0-4.5
Sample No.: S-3
Color: Brown
(Minus No. 40 sieve material)

As Received Water Content

Tare Number	42
Wt. of Tare & Wet Sample (g)	38.71
Wt. of Tare & Dry Sample (g)	36.62
Weight of Tare (g)	6.90
Weight of Water (g)	2.09
Weight of Dry Sample (g)	29.72

Water Content (%) **7.0**

NON - PLASTIC MATERIAL

Tested By *RAL* *Date* *7/7/17* *Checked By* *KC* *Date* *7/8/17*

SIEVE AND HYDROMETER ANALYSIS

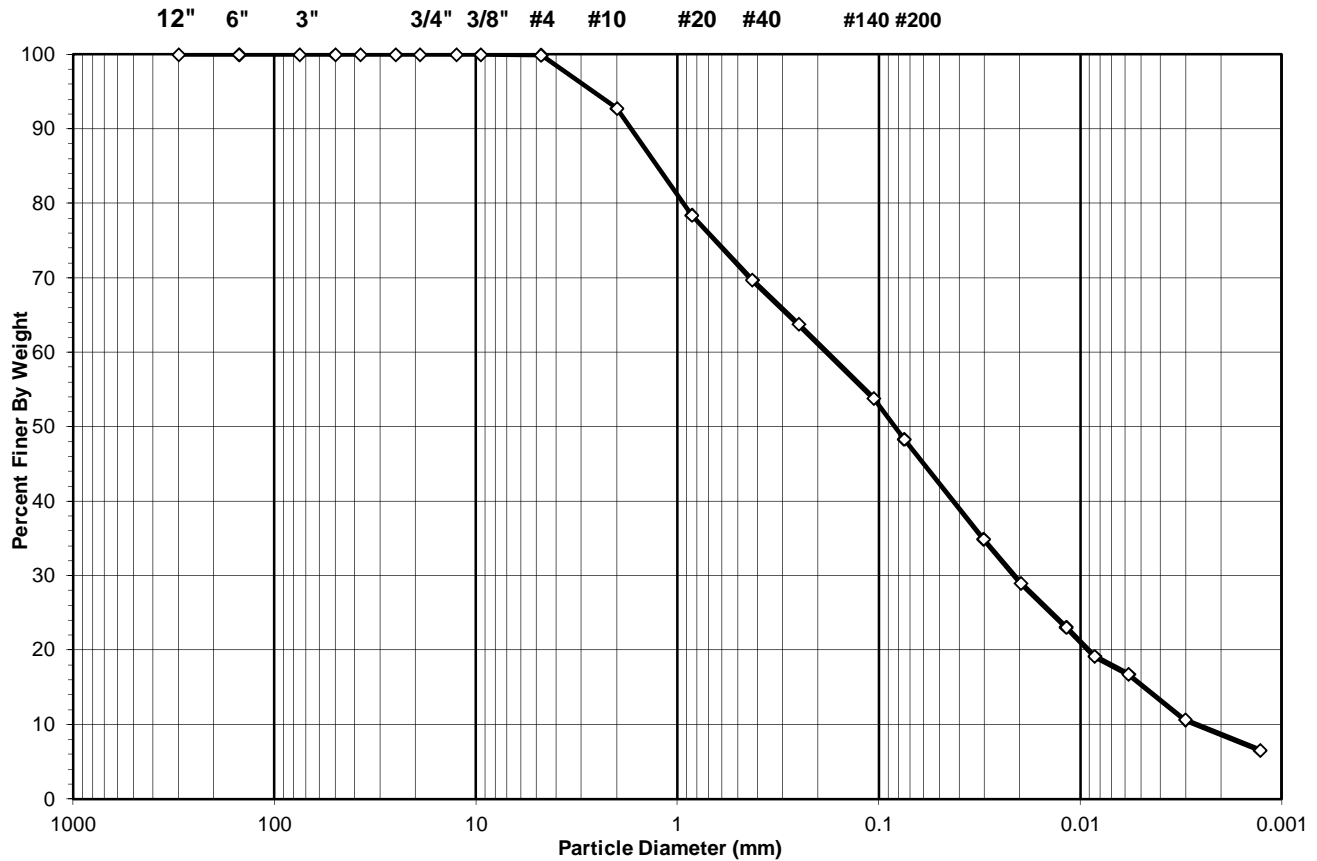
ASTM D 422-63 (2007)



Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-004

Boring No.: NV-4
 Depth (ft): 4.5-6.0
 Sample No.: S-7
 Soil Color: Gray

USCS USDA	SIEVE ANALYSIS					HYDROMETER	
	cobbles	gravel		sand		silt and clay fraction	
	cobbles	gravel		sand		silt	clay



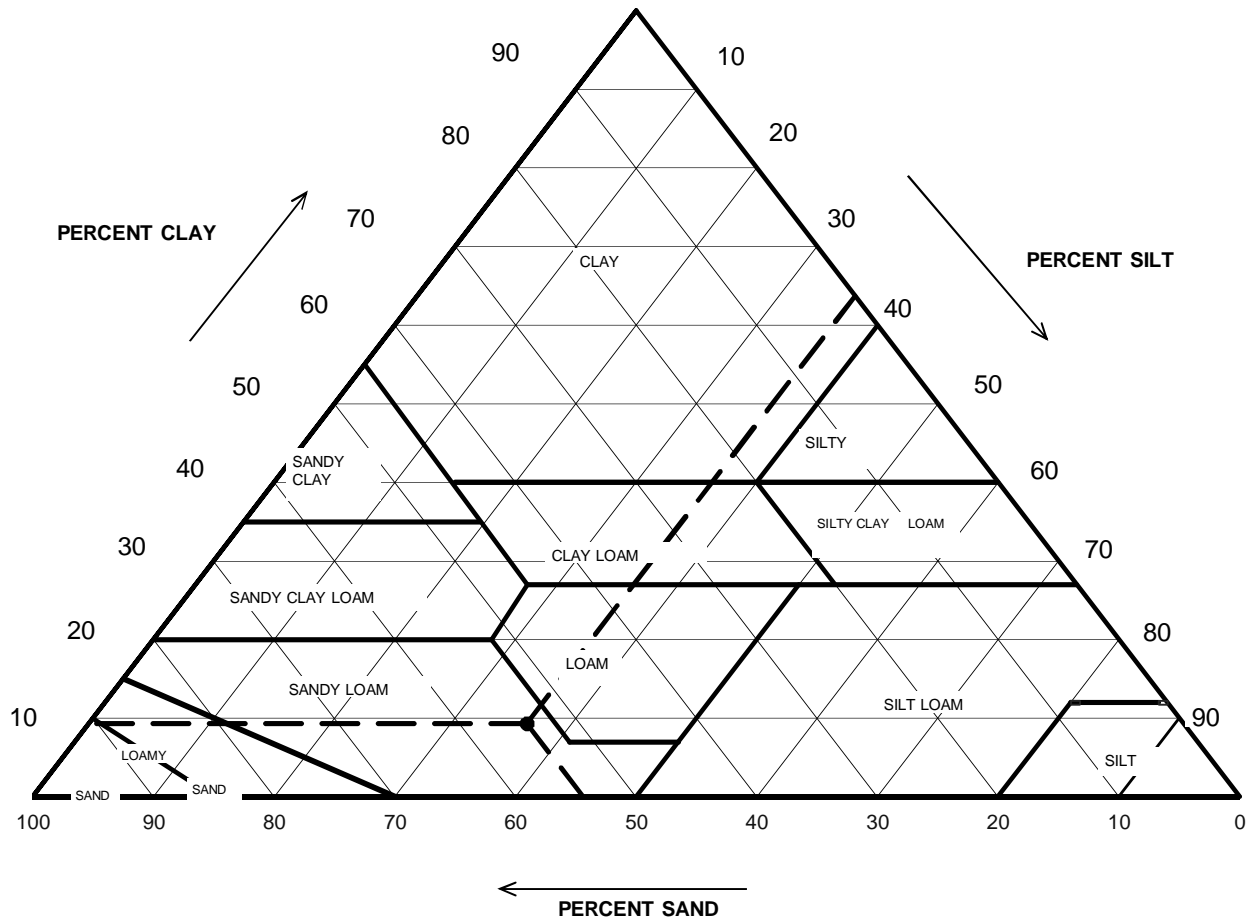
USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.7
#4 To #200	Sand	51.59
Finer Than #200	Silt & Clay	48.34

USCS Symbol: SM, TESTED		
USCS Classification: SILTY SAND (NON-PLASTIC FINES)		

USDA CLASSIFICATION CHART

Client: SCI-TEK Consultants
Client Reference: Northview Heights-Midrise 17-781
Project No.: 2017-355-001
Lab ID: 2017-355-001-004

Boring No.: NV-4
Depth (ft): 4.5-6.0
Sample No.: S-7
Soil Color: Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	92.77	Gravel	7.23	0.00
0.05	42.33	Sand	50.44	54.37
0.002	8.67	Silt	33.66	36.28
		Clay	8.67	9.35
		USDA Classification:	SANDY LOAM	

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-004

Boring No.: NV-4
 Depth (ft): 4.5-6.0
 Sample No.: S-7
 Soil Color: Gray

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1428	Tare No.	NA
Weight of Tare & Wet Sample (g)	366.56	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	333.23	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	145.39	Weight of Tare (g)	NA
Weight of Water (g)	33.33	Weight of Water (g)	NA
Weight of Dry Sample (g)	187.84	Weight of Dry Sample (g)	NA
Moisture Content (%)	17.7	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	187.84
Dry Weight of -3/4" Sample (g)	97.03	Weight of - #200 Material (g)	90.81
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	97.03
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	100.00
6"	150	0.00	0.00	0.00		100.00	100.00
3"	75	0.00	0.00	0.00		100.00	100.00
2"	50	0.00	0.00	0.00		100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00		100.00	100.00
1"	25.0	0.00	0.00	0.00		100.00	100.00
3/4"	19.0	0.00	0.00	0.00		100.00	100.00
1/2"	12.5	0.00	0.00	0.00		100.00	100.00
3/8"	9.50	0.00	0.00	0.00		100.00	100.00
#4	4.75	0.13	0.07	0.07		99.93	99.93
#10	2.00	13.45	7.16	7.23		92.77	92.77
#20	0.85	26.93	14.34	21.57		78.43	78.43
#40	0.425	16.38	8.72	30.29		69.71	69.71
#60	0.250	11.13	5.93	36.21		63.79	63.79
#140	0.106	18.74	9.98	46.19		53.81	53.81
#200	0.075	10.27	5.47	51.66		48.34	48.34
Pan	-	90.81	48.34	100.00		-	-

Tested By HL/TV Date 7/13/17 Checked By TMP Date 7/17/17

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-004

Boring No.: NV-4
 Depth (ft): 4.5-6.0
 Sample No.: S-7
 Soil Color: Gray

Elapsed Time	R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)		(°C)			(%)		(mm)	(%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	32.5	23.3	5.89	26.6	72.2	0.01293	0.0303	34.9
5	28.0	23.3	5.89	22.1	60.0	0.01293	0.0198	29.0
15	23.5	23.3	5.89	17.6	47.8	0.01293	0.0118	23.1
30	20.5	23.3	5.89	14.6	39.6	0.01293	0.0085	19.2
66	18.5	23.8	5.71	12.8	34.7	0.01285	0.0058	16.8
250	13.5	24.7	5.39	8.1	22.0	0.01272	0.0030	10.6
1440	10.5	24.4	5.50	5.0	13.6	0.01276	0.0013	6.6

Soil Specimen Data		Other Corrections	
Tare No.	685		
Weight of Tare & Dry Material (g)	140.54	a - Factor	0.99
Weight of Tare (g)	99.04		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	48.34
Weight of Dry Material (g)	36.5	Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

ATTERBERG LIMITS

ASTM D 4318-10

Client: SCI-TEK Consultants
Client Reference: Northview Heights-Midrise 17-781
Project No.: 2017-355-001
Lab ID: 2017-355-001-004

Boring No.: NV-4
Depth (ft): 4.5-5.0
Sample No.: S-4
Color: Gray
(Minus No. 40 sieve material)

As Received Water Content

Tare Number	47
Wt. of Tare & Wet Sample (g)	39.53
Wt. of Tare & Dry Sample (g)	38.90
Weight of Tare (g)	6.65
Weight of Water (g)	0.63
Weight of Dry Sample (g)	32.25

Water Content (%) **2.0**

NON - PLASTIC MATERIAL

Tested By *RAL* *Date* *7/7/17* *Checked By* *KC* *Date* *7/8/17*

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)



Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-005

Boring No.: NV-9A
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Color: Gray



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.00
#4 To #200	Sand	7.40
Finer Than #200	Silt & Clay	92.60
USCS Symbol: CL, TESTED		
USCS Classification: LEAN CLAY		

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-005

Boring No.: NV-9A
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Color: Gray

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1480	Tare No.	NA
Weight of Tare & Wet Sample (g)	330.80	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	330.80	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	147.87	Weight of Tare (g)	NA
Weight of Water (g)	0.00	Weight of Water (g)	NA
Weight of Dry Sample (g)	182.93	Weight of Dry Sample (g)	NA
Moisture Content (%)	0.0	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	182.93
Dry Weight of -3/4" Sample (g)	13.53	Weight of - #200 Material (g)	169.40
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	13.53
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	100.00
6"	150	0.00	0.00	0.00		100.00	100.00
3"	75	0.00	0.00	0.00		100.00	100.00
2"	50	0.00	0.00	0.00		100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00		100.00	100.00
1"	25.0	0.00	0.00	0.00		100.00	100.00
3/4"	19.0	0.00	0.00	0.00		100.00	100.00
1/2"	12.5	0.00	0.00	0.00		100.00	100.00
3/8"	9.50	0.00	0.00	0.00		100.00	100.00
#4	4.75	0.00	0.00	0.00		100.00	100.00
#10	2.00	2.25	1.23	1.23		98.77	98.77
#20	0.85	3.35	1.83	3.06		96.94	96.94
#40	0.425	2.15	1.18	4.24		95.76	95.76
#60	0.250	1.67	0.91	5.15		94.85	94.85
#140	0.106	2.92	1.60	6.75		93.25	93.25
#200	0.075	1.19	0.65	7.40		92.60	92.60
Pan	-	169.40	92.60	100.00		-	-

Tested By HL/TV Date 7/13/17 Checked By TMP Date 7/17/17

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-005

Boring No.: NV-9A
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Color: Gray

Elapsed Time	R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)		(°C)			(%)		(mm)	(%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	39.5	24.4	5.50	34.0	93.8	0.01276	0.0283	86.9
5	39.0	24.4	5.50	33.5	92.4	0.01276	0.0180	85.6
23	36.5	24.4	5.50	31.0	85.5	0.01276	0.0085	79.2
30	35.5	24.4	5.50	30.0	82.8	0.01276	0.0075	76.6
60	33.0	23.7	5.75	27.2	75.2	0.01287	0.0055	69.6
250	26.0	24.4	5.50	20.5	56.6	0.01276	0.0028	52.4
1440	19.5	24.3	5.53	14.0	38.5	0.01278	0.0012	35.7

Soil Specimen Data		Other Corrections	
Tare No.	649		
Weight of Tare & Dry Material (g)	137.70	a - Factor	0.99
Weight of Tare (g)	96.81		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	92.60
Weight of Dry Material (g)	35.9	Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

ATTERBERG LIMITS

ASTM D 4318-10

Client: SCI-TEK Consultants
 Client Reference: Northview Heights-Midrise 17-781
 Project No.: 2017-355-001
 Lab ID: 2017-355-001-005

Boring No.: NV-9A
 Depth (ft): 7.5-9.0
 Sample No.: S-6
 Soil Description: GRAY LEAN CLAY

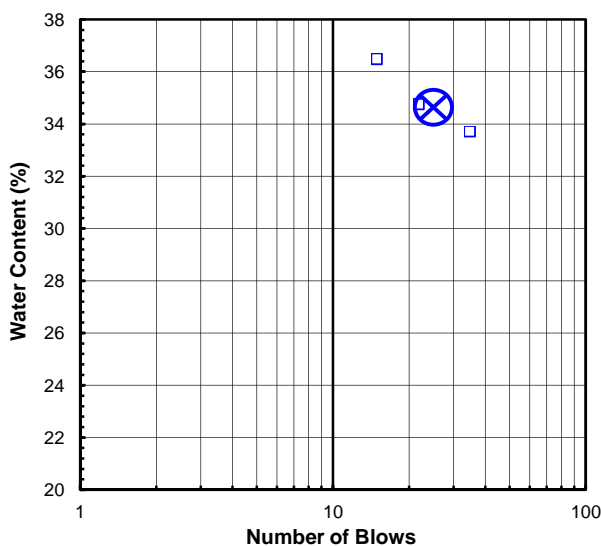
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	50	161	209	150	U
Wt. of Tare & Wet Sample (g):	33.78	38.09	39.68	40.04	L
Wt. of Tare & Dry Sample (g):	32.27	32.68	34.43	34.93	T
Weight of Tare (g):	6.82	17.84	19.31	19.76	I
Weight of Water (g):	1.5	5.4	5.3	5.1	P
Weight of Dry Sample (g):	25.5	14.8	15.1	15.2	O
Was As Received MC Preserved:	Yes				I
Moisture Content (%):	5.9	36.5	34.7	33.7	N
Number of Blows:		15	22	35	T

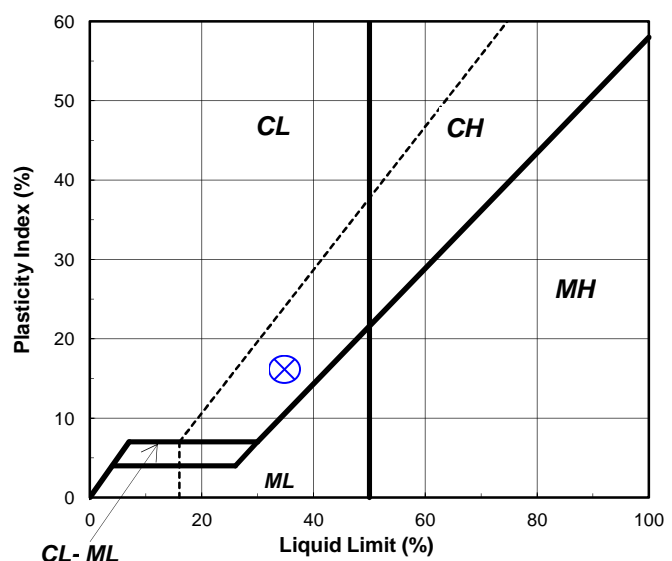
Plastic Limit Test	1	2	Range	Test Results	
Tare Number:	188	229		Liquid Limit (%):	35
Wt. of Tare & Wet Sample (g):	24.66	24.47		Plastic Limit (%):	19
Wt. of Tare & Dry Sample (g):	23.64	23.46		Plasticity Index (%):	16
Weight of Tare (g):	18.26	18.18		USCS Symbol:	CL
Weight of Water (g):	1.0	1.0			
Weight of Dry Sample (g):	5.4	5.3			
Moisture Content (%):	19.0	19.1	-0.2		

Note: The acceptable range of the two Moisture contents is ± 1.4

Flow Curve



Plasticity Chart



Tested By RAL Date 7/10/17 Checked By TMP Date 7/11/17

APPENDIX D

DEFINITIONS AND LIMITATIONS

DEFINITIONS AND LIMITATIONS

1.0 DEFINITIONS

The following definitions are provided to aid in better understanding of the terms and contents of this report. These definitions may or may not be specifically applicable to this particular report. Please contact us if any questions exist concerning terms contained in this report.

Disturbed Samples: Soils are sampled using a standard 2-inch outside diameter (O.D.) 1.375-inch inside diameter (I.D.) split-spoon sampler. The split-spoon sampler is also termed a split-barrel sampler.

Standard Penetration Test (SPT): The standard split-spoon sampler is driven using a 140-pound hammer falling 30 inches. The sampler is driven 18 inches into soil or until the sampler is refused on rock. The top-of-rock is defined as at least 50 blows per 0.5-foot penetration of soil. The number of blows to drive the sampler through each 6-inch interval of soil is recorded on the Test Boring Logs. The number of blows per foot (N) required to drive the sampler may be an indication of the relative density or consistency of the soil. The N value is usually calculated by omitting the blow count for the first one-half foot penetration of soil.

Shelby Tube: A Shelby tube is a 3-inch O.D. seamless, thin wall metal tube. Shelby tubes are pushed using hydraulically driven drilling tools. Tubes are pushed into the soil for the purpose of obtaining a relatively undisturbed sample.

Visual Soil Descriptions: The sample descriptions on the Test Boring Records use the following terms:

PRINCIPAL CONSTITUENTS, other constituents, color, consistency or relative density, moisture content and other information.

The relative percentage of each constituent is indicated in the following manner:

and	35+ percent (co-principals)
(y) or (ey)	20 to 34 percent (i.e.; silty or clayey)
some	15 to 19 percent
little	11 to 15 percent
trace	0 to 10 percent

Residual Soils and Decomposed Bedrock: Soils formed in place by the disintegration and decomposition of rocks and the consequent weathering of the mineral materials.

Colluvial Soils: Loose and incoherent soil deposits usually at the foot of slopes or cliffs and brought there chiefly by gravity.

Alluvial Soils: Soils that are transported and deposited by water.

Fill: Materials consisting of natural soils and/or waste materials that were deposited by man.

Loess: Wind-blown sediments.

Glacial Till: Soils that have been transported and deposited by glaciers.

Top of Bedrock: The top of bedrock is generally defined by us as the point at which continuous core drilling is used to advance the test borings.

Base of Primary Weathering (B1W): This is the point below which it is visually estimated the rock becomes relatively unweathered and where clay seams and extensive staining due to groundwater activity are generally absent.

Visual Rock Descriptions: The sample descriptions on the Test Boring Logs use the following terms:

PRINCIPAL ROCK TYPE, accessory constituents, accessory rock types, color, hardness, weathering, bed thickness, bedding inclination, fracture spacing, fracture inclination, and other information.

The relative percentage of accessory rock types is indicated in the following manner:

and	35+ percent (co-principals)
(y) or (ey)	20 to 34 percent (i.e.; sandy)
some	15 to 19 percent
little	10 to 14 percent
trace	0 to 10 percent

Claystone: Clay size particles compacted by overburden pressure to form bedrock.

Sandstone: Cemented or otherwise compacted particles or fragments from eroded pre-existing rocks composed predominantly of quartz grains, the grades of the latter being those of sand.

Shale: A laminated sedimentary rock in which the principal constituent particles are clay particles compacted by overburden pressure.

Limestone: A bedded sedimentary deposit consisting chiefly of calcium or magnesium carbonate. It is the consolidated equivalent of limey mud, calcareous sand, and shell fragments.

Siltstone: Cemented or otherwise compacted particles or fragments from eroded pre-existing rocks composed predominantly of quartz grains, the grades of the latter being those of silt.

Cemented Shale: Hardened shale, the mineral particles of which are bound by siliceous or calcareous cement.

Compaction Shale: A shale type that was formed by compaction rather than cementation.

Banded: The property of rocks having thin and nearly parallel bands of different textures, colors, or minerals.

Laminations: Bedding in thin layers that vary in grain size or composition.

Slickenside: The polished surface on interior joints or rock mass.

Streaks: Some mineral constituents so arranged as to give the rock a striped or streaked appearance.

Parting: Thin layers of shale occurring in a coal seam.

Inclusions: The fragments of one rock type enclosed in another rock type.

Broken: A descriptive term for recovered core samples, which indicates the rock sample was mechanically broken vertically and/or diagonally.

Calcareous: Descriptive term, which indicates some reaction to hydrochloric acid.

Stained: Descriptive term, which indicates discoloration on the surface of rock core samples.

Interbedded: Used to indicate an alternating sequence of seams of two rock types.

Bedding: The bedding of the rock is based on the spacing of bedding contacts for each distinct rock type layer as indicated in the following table.

<u>Term</u>	<u>Bed Thickness</u>
Massive	Bed 3 - 10 feet
Thick	Bed 1 - 3 feet
Moderate	Bed 4 - 12 inches
Thin	Bed 1 - 4 inches
Very Thin	Bed 1/2 - 1 inches
Laminated	Bed less than 1/2 inch
Indistinct	Bed thickness not discernible due to weathering or cementation

Fracturing: The fracturing of the rock is based on the core recovery as indicated in the following table.

<u>Term</u>	<u>Fracture Spacing</u>
Very Wide	Core pieces 3 - 10 feet
Wide	Core pieces 1 - 3 feet
Moderate	Core pieces 4 - 12 inches
Close	Core pieces 1 - 4 inches
Very Close	Core pieces 1/2 - 1 inch
Fissile	Core pieces less than 1/2 inch

2.0 LIMITATIONS

The following limitations apply to this report:

Third Party Reliance: No party, other than Sci-Tek's client for which this report was originally written, is entitled to rely on this report without Sci-Tek's written consent. If any other party relies on or reuses this report without Sci-Tek's written permission, Sci-Tek shall not be liable for any claims, damages, losses, or expenses resulting from such unauthorized reliance or reuse. In the event that others base decisions on the conclusions, recommendations, or data obtained in this report, such decisions are the responsibility of those others.

Warranty: Sci-Tek prepared this report in accordance with generally accepted soil and foundation engineering practices for our client's use. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Design Changes: In the event that the final design differs with respect to function, purpose, location, layout or elevation from that on which we based this report, Sci-Tek must review the applicability of our recommendations with respect to the proposed final design.

Time Obsolescence: Since site and subsurface conditions change with time, the data obtained, conclusions and recommendations in this report become obsolete with the passage of time depending on the nature and extent of any changes, and the amount of time that passes.

Subsurface Variations: The conclusions and recommendations submitted in this report are based upon limited data obtained at the test boring locations. This report does not reflect any variations that naturally and most likely occur between the test borings. The nature and extent of variations between the test borings will not become evident until additional test borings are drilled, or construction is performed at the Site. Consequently, if at any time fill, soil, rock, and groundwater conditions appear to be different from those described herein, Sci-Tek must be advised at once so that we can reevaluate the recommendations in light of actual site conditions.

Water Readings: The water level readings are shown on the Field Test Boring Logs. The water levels measured after drilling may not be indicative of the true groundwater levels in the test borings because the water level may not have stabilized before backfilling.

Water Level Variations: Fluctuations in the level of the groundwater may occur depending on the time of the year and the amount of precipitation. Design drawings and specifications should accommodate such possibilities and construction planning should be based upon assumed variations.

DOCUMENT 00 31 43 - PERMIT APPLICATION

1.1 PERMIT APPLICATION INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. This Document and its attachments are not part of the Contract Documents.
- B. Permit Application: Complete building permit application and file with authorities having jurisdiction within five days of the date of execution of the Contract.
- C. Permit Application: The building permit for Project has been applied for by Architect . A copy of the Permit Application is .

END OF DOCUMENT 00 31 43

DOCUMENT 00 43 23 – DEDUCT ALTERNATES FORM

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Prime Contract: _____.
- C. Project Name: Northview Heights Midrise Development.
- D. Project Location: 246 Penfort Street, Pittsburgh, Pennsylvania, 15214, United States.
- E. Owner: Allies & Ross Management and Development Corporation (ARMDC).
- F. Owner Project Number: PHFA No. 2021-156.
- G. Architect: Fukui Architects.
- H. Architect Project Number: #2040 .
- I. Construction Manager: _____.

1.2 BID FORM SUPPLEMENT

- A. This form is required to be attached to the Bid Form.

1.3 DESCRIPTION

- A. The undersigned Bidder proposes the amount below be deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.
 - 1. Cost-Plus-Fee Contract: Alternate price given below includes adjustment to Contractor's Fee.
- B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."
- C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."
- D. The Bidder shall be responsible for determining from the Contract Documents the affects of each alternate on the Contract Time and the Contract Sum.
- E. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within [60] days of the Notice of Award unless otherwise indicated in the Contract Documents.

- F. Acceptance or non-acceptance of any alternates by the Owner shall have no affect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time.

1.4 SCHEDULE OF DEDUCT ALTERNATES

- A. Deduct Alternate No. <Insert number> : <Insert title of alternate>:

1. DEDUCT___ NO CHANGE___ NOT APPLICABLE___.
2. _____ Dollars (\$_____).
3. DEDUCT___ calendar days to adjust the Contract Time for this alternate.

1.5 SUBMISSION OF BID SUPPLEMENT

- A. Respectfully submitted this ___ day of _____, <Insert year>.
- B. Submitted By: _____ (Name of bidding firm or corporation).
- C. Authorized Signature: _____ (Handwritten signature).
- D. Signed By: _____ (Type or print name).
- E. Title: _____ (Owner/Partner/President/Vice President).

END OF DOCUMENT 00 43 23

SECTION 00 60 00 - PROJECT FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
 - 1. AIA Document A101-2017 "Standard Form of Agreement between Owner and Contractor Where the Basis of Payment is a Stipulated Sum."
 - a. The General Conditions for Project are AIA Document A201-2017 "General Conditions of the Contract for Construction."
 - 2. The General Conditions are included in the Project Manual.

1.2 ADMINISTRATIVE FORMS

- A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.
- B. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732.
- C. Preconstruction Forms:
 - 1. Form of Performance Bond and Labor and Material Bond: AIA Document A312-2010 "Performance Bond and Payment Bond."
 - 2. Form of Certificate of Insurance: AIA Document G715-2017 "Supplemental Attachment for ACORD Certificate of Insurance 25."
- D. Information and Modification Forms:
 - 1. Form for Requests for Information (RFIs): AIA Document G716-2004 "Request for Information (RFI)."
 - 2. Form of Request for Proposal: AIA Document G709-2018 "Proposal Request."
 - 3. Change Order Form: AIA Document G701-2017 "Change Order."
 - 4. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G710-2017 "Architect's Supplemental Instructions."
 - 5. Form of Change Directive: AIA Document G714-2017 "Construction Change Directive."
- E. Payment Forms:
 - 1. Schedule of Values Form: AIA Document G703-1992 "Continuation Sheet."
 - 2. Payment Application: AIA Document G702-1992/703-1992 "Application and Certificate for Payment and Continuation Sheet."
 - 3. Form of Contractor's Affidavit: AIA Document G706-1994 "Contractor's Affidavit of Payment of Debts and Claims."
 - 4. Form of Affidavit of Release of Liens: AIA Document G706A-1994 "Contractor's Affidavit of Payment of Release of Liens."

5. Form of Consent of Surety: AIA Document G707-1994 "Consent of Surety to Final Payment."

END OF DOCUMENT 00 60 00

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

HACP - Northview Heights Midrise
Pittsburgh, PA

THE OWNER:

(Name, legal status and address)

Allies & Ross Management and Development Corporation, General Corporation
200 Ross Street
9th Floor
Pittsburgh, PA 15219

THE ARCHITECT:

(Name, legal status and address)

Fukui Architects Pc, Professional Corporation
205 Ross Street
Pittsburgh, PA 15219

TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 OWNER
- 3 CONTRACTOR
- 4 ARCHITECT
- 5 SUBCONTRACTORS
- 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
- 7 CHANGES IN THE WORK
- 8 TIME
- 9 PAYMENTS AND COMPLETION
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- 11 INSURANCE AND BONDS
- 12 UNCOVERING AND CORRECTION OF WORK
- 13 MISCELLANEOUS PROVISIONS
- 14 TERMINATION OR SUSPENSION OF THE CONTRACT

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

Init.

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User Notes:

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15 CLAIMS AND DISPUTES



Init.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent

consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements,

assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the

Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the

Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations

and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor,

prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work,

promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will

affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and

unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 **Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 **Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to

the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,

the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the

Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

Additions and Deletions Report for

AIA® Document A201® – 2017

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

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PAGE 1

HACP - Northview Heights Midrise
Pittsburgh, PA

...

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...

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Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, Kento Ohmori, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 16:40:09 ET on 03/06/2022 under Order No. 1888938652 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ - 2017, General Conditions of the Contract for Construction, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 01 21 00 "Allowances" for procedures for using unit prices to adjust quantity allowances.

1.2 DEFINITIONS

- A. Unit price is [**an amount incorporated into the Agreement, applicable during the duration of the Work as**] a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, [**applicable taxes,**] overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.

SECTION 01 22 00 - UNIT PRICES

01 22 00 - 1

1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 31 20 00 "Earth Moving."
2. Unit of Measurement: <Insert cubic yard> of soil excavated, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."

B. Unit Price No. <Insert unit-price number> - <Insert unit-price item>:

1. Description: <Insert unit-price item description> according to Section <Insert Section number> "<Insert Section title>."
2. Unit of Measurement: <Insert unit of measurement>.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."

END OF SECTION 01 22 00

SECTION 01 23 00 – DEDUCT ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for deduct alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of deduct alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF DEDUCT ALTERNATES

- A. Deduct Alternate No. 001 : Exterior Lap Siding.

SECTION 01 23 00 - ALTERNATES

01 23 00 - 1

1. Base Bid: Vented Cementitious Horizontal Lap Siding, 6.25" width, as indicated on Drawing A201 and A202 and as specified in Section 07 46 46 "Fiber Cement Siding."
2. Deduct Alternate: Unvented Cementitious Horizontal Lap Siding, 6.25" width, as specified in Section 07 46 46 "Fiber Cement Siding."
3. Deduct Alternate: Vented Vinyl Horizontal Lap Siding, 6" width, as specified in Section 07 46 33 "Plastic Siding."
4. Deduct Alternate: Unvented Vinyl Horizontal Lap Siding, 6" width, as specified in Section 07 46 33 "Plastic Siding."

B. Deduct Alternate No. 002 : Kitchen Countertops.

1. Base Bid: Quartz Agglomerate Countertops for the Community Room Kitchenette and the Unit Kitchens as indicated on Drawing A401 through A421 and A513 and as specified in Section 12 36 61.19 "Quartz Agglomerate Countertops."
2. Deduct Alternate: Solid Surface Countertops as specified in Section 06 61 16 "Solid Surfacing Fabrications."
3. Deduct Alternate: Plastic Laminate Countertops as specified in Section 12 36 23.13 "Plastic-Laminate-Clad Countertops."

C. Deduct Alternate No. 003 : ADA Slide-In Range with Oven.

1. Base Bid: 34" Height ADA Slide-In Range with Oven for the Community Room Kitchenette and the Type-A Unit Kitchens as indicated on Drawing A401 through A421 and A513 and as specified in Section 11 30 13 "Residential Appliances."
2. Deduct Alternate: 36" Height ADA Slide-In Range with Oven as specified in Section 11 30 13 "Residential Appliances."

D. Deduct Alternate No. 004 : Interior Unit Doors

1. Base Bid: Pre-Hung Solid Wood Core Doors in Wood Frame for all Interior Unit Doors, not including the Unit Entry Doors, as indicated on Drawing A401 through A420 and as specified in Section 08 14 16 "Flush Wood Doors."
2. Deduct Alternate: Pre-Hung Hollow Core Wood Doors in Wood frame as specified in Section 08 14 16 "Flush Wood Doors."

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 1.5C. SUBSTITUTION REQUEST .
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific

- features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES .
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - <Click to insert sustainable design text for requested substitution.>
 - Substitution request is fully documented and properly submitted.
 - Requested substitution will not adversely affect Contractor's construction schedule.
 - Requested substitution has received necessary approvals of authorities having jurisdiction.
 - Requested substitution is compatible with other portions of the Work.
 - Requested substitution has been coordinated with other portions of the Work.
 - Requested substitution provides specified warranty.
 - If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - Requested substitution does not require extensive revisions to the Contract Documents.
 - Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - <Click to insert sustainable design text for requested substitution.>
 - Substitution request is fully documented and properly submitted.
 - Requested substitution will not adversely affect Contractor's construction schedule.
 - Requested substitution has received necessary approvals of authorities having jurisdiction.
 - Requested substitution is compatible with other portions of the Work.
 - Requested substitution has been coordinated with other portions of the Work.
 - Requested substitution provides specified warranty.

- k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Section 01 91 13 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.2 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 - b. DWG, Version 2020 or later.
 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available as DWG.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Owner name.
 2. Owner's Project number.
 3. Name of Architect.
 4. Architect's Project number.
 5. Date.
 6. Name of Contractor.
 7. RFI number, numbered sequentially.
 8. RFI subject.
 9. Specification Section number and title and related paragraphs, as appropriate.
 10. Drawing number and detail references, as appropriate.
 11. Field dimensions and conditions, as appropriate.
 12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 13. Contractor's signature.

14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - C. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.
 - E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 - F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- 1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in DWG.
 4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
 - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual.
 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. (Optional) Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 2. Provide up to seven web-based Project management software user licenses for use of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
 3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.

- cc. Progress cleaning.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Sustainable Design Requirements Coordination Conference: Owner will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner, Construction Manager, Architect, and Contractor.
- 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:
 - a. Sustainable design Project checklist.
 - b. General requirements for sustainable design-related procurement and documentation.
 - c. Project closeout requirements and sustainable design certification procedures.
 - d. Role of sustainable design coordinator.
 - e. Construction waste management.
 - f. Construction operations and sustainable design requirements and restrictions.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.

- p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- E. Progress Meetings: Conduct progress meetings at regular intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Status of sustainable design documentation.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.

- 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Site condition reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
 2. PDF file.
 3. Two paper copies, of sufficient size to display entire period or schedule, as required.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- C. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. .
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 15 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- E. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

- G. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.

4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.

10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Use paper submittals only when submittals can not be made electronically. All submittals for color, texture, or other physical characteristics must include a physical product being reviewed accompanied by a paper transmittal.
2. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
3. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
4. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
5. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 transmittal form.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals for Utilizing Web-Based Project Management Software: Prepare submittals as PDF files, or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
 3. Paper: Prepare submittals in paper form, and deliver to Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.

- h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 - a. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 2 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
 3. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
 - a. Actions taken by indication on Project management software website have the following meanings:
 - 1) "Approved" means that the Architect has not taken exception to what was submitted. It does not mean that the Architect has approved a condition that alters the contract documents or accepted a substitution or alternate unless specifically requested and specifically acknowledged by the Architect.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 43 39 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.
2. Room mockups.

1.2 DEFINITIONS

- A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
- B. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior and room mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review testing procedures to be performed on mockups.
5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
- B. Build mockups to do the following:

1. Verify selections made under Sample submittals.
 2. Demonstrate aesthetic effects.
 3. Demonstrate the qualities of products and workmanship.
 4. Demonstrate acceptable coordination between components and systems.
 5. Perform preconstruction testing, such as window air- and water-leakage testing.
- C. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed unless otherwise indicated.
- D. Notifications:
1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
 2. Notify Architect 14 days in advance of the dates and times when mockups will be tested.
 3. Allow seven days for initial review and each re-review of each mockup.
- E. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.
1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 COORDINATION

- A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

2.2 INTEGRATED EXTERIOR MOCKUPS

- A. Construct integrated exterior mockups . Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.
- C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.
- D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.
- E. The Work of integrated exterior mockups includes, but is not limited to, the following:
 - 1. Masonry veneer.
 - 2. Cold-formed metal framing and sheathing.
 - 3. Air and weather barriers.
 - 4. Thermal insulation.
 - 5. Through-wall flashing.
 - 6. Flashing and sheet metal trim.
 - 7. Joint sealants.
 - 8. Aluminum-framed entrances and storefront.
 - 9. Glazing.
 - 10. **<Insert description>**.
- F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 01 32 33 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.
 - 1. Document testing procedures, including water leakage and other deficiencies. Photograph modifications to component interfaces intended to correct deficiencies.
- G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

- H. Retain approved mockups constructed in place. Incorporate fully into the Work.

2.3 ROOM MOCKUPS

- A. Build room mockups to evaluate constructability, demonstrate the coordination of trades and sequencing of Work, and to demonstrate aesthetic requirements. Include each visible finish, component, and equipment item within room mockups; include operable lighting.
- B. Provide room mockups of the following rooms:
 - 1. Residential apartment unit.
 - 2. .
- C. The Work of room mockups includes, but is not limited to, the following:
 - 1. Millwork and casework.
 - 2. Doors and frames.
 - 3. Access doors and frames.
 - 4. Glazing.
 - 5. Gypsum board.
 - 6. Resilient flooring.
 - 7. Painting.
 - 8. Registers and grilles.
 - 9. Wiring devices.
 - 10. Lighting.
 - 11. <Insert description>.

PART 3 - EXECUTION

3.1 TESTING OF INTEGRATED EXTERIOR MOCKUPS

- A. Integrated Exterior Mockup Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Integrated Exterior Mockup Testing Services: Perform the following tests in the following order:
 - 1. Water-Spray Test: Before installation of interior finishes has begun, test areas designated by Architect in accordance with AAMA 501.2 for evidence of water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
 - 2. Air Leakage: Test in accordance with ASTM E783 at 1.5 times the rate specified in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 - a. Perform a minimum of two tests in areas as directed by Architect.

3. Water Penetration: Test in accordance with ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and verify no evidence of water penetration.
- C. .
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.
1. Curtain wall specified in Section 08 44 13 "Glazed Aluminum Curtain Walls."
 2. Sheathing with integrated air and water barrier including insulated sheathing .
- E. Integrated exterior mockup will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 01 43 39

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.2 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. <Click to insert sustainable design text for erosion- and sedimentation-control plan.>
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.

1.3 QUALITY ASSURANCE

1.4 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 "Closeout Procedures."

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment land-based telephone line(s) for each field office.
- H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- I. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 1. Processor: Intel Core i5 or i7.
 2. Memory: 16 gigabyte.
 3. Disk Storage: 1 -terabyte hard-disk drive.
 4. Display: 24-inch LCD monitor with 256-Mb dedicated video RAM.
 5. Full-size keyboard and mouse.
 6. Network Connectivity: Gigabit.
 7. Operating System: Microsoft Windows 10 Professional.
 8. Productivity Software:
 - a. Microsoft Office Professional, 2013 or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader DC.
 - c. WinZip 10.0 or higher.
 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 10. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.
 11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 12. Backup: External hard drive, minimum 2 terabytes, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.
 2. Utilize designated area within existing building for temporary field offices.

3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 31 10 00 "Site Clearing."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 01 56 39 "Temporary Tree and Plant Protection."
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- G. Site Enclosure Fence: Before construction operations begin , furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations .
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.

- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard and replace stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
- F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
 - 1. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 - 2. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 - 3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or

indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."
 - 1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
 - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for coordination of Owner-furnished products , Owner's separate contracts, and limits on use of Project site.
 - 2. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 3. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor , certifying that location and elevation of improvements comply with requirements.

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

- C. **Cleaning Agents:** Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. **Existing Conditions:** The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. **Examination and Acceptance of Conditions:** Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. **Written Report:** Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. **Proceed with installation only after unsatisfactory conditions have been corrected.** Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 10 00 "Summary."

- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous construction waste.
 - 2. Disposing of nonhazardous construction waste.
- B. Related Requirements:
 - 1. Section 01 12 00 "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. Section 04 20 00 "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Section 04 43 13.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 4. Section 04 43 13.16 "Adhered Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 5. Section 31 10 00 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work .

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

- A.

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A.

SECTION 01 74 19 - CONSTRUCTION WASTE
MANAGEMENT AND DISPOSAL

01 74 19 - 2

1. .

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.
- E.

3.2 SALVAGING DEMOLITION WASTE

- A.
- B. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for : on Project site.

3.3 RECYCLING [AND] CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor .
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Store components off the ground and protect from the weather.
 - 4. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

3.5 ATTACHMENTS

END OF SECTION 01 74 19

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect or by email to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect will return two copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- D. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Architect.
 - 7. Name and contact information for Commissioning Authority.
 - 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Gas leak.
 3. Water leak.
 4. Power failure.
 5. Water outage.
 6. System, subsystem, or equipment failure.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

01 78 23 - 6

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
- B. Related Requirements:
 - 1. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1)
 - 2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
 - 3) Submit Record Digital Data Files and 3 set(s) of plots.
 - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1)
 - 2) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
 - c. Final Submittal:
 - 1)
 - 2) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files and 3 paper copies of Project's Specifications, including addenda and Contract modifications.

- C. Record Product Data: Submit annotated PDF electronic files and directories and 3 paper copies of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders , Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file .

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.

- b. Equipment or system break-in procedures.
- c. Routine and normal operating instructions.
- d. Regulation and control procedures.
- e. Control sequences.
- f. Safety procedures.
- g. Instructions on stopping.
- h. Normal shutdown instructions.
- i. Operating procedures for emergencies.
- j. Operating procedures for system, subsystem, or equipment failure.
- k. Seasonal and weekend operating instructions.
- l. Required sequences for electric or electronic systems.
- m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner , through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on CD-ROM or thumb drive .
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

SECTION 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The drawings and specifications for this Project have been generated to be compliant with the requirements of 2020 Enterprise Green Communities (hereinafter, EGC), and to meet the EGC certification goals. This Section contains general requirements and procedures for compliance with EGC's mandatory criteria and some of its optional criteria, identified during the design of this Project, that will lead to achievement of EGC certification.
 - 1. Specific requirements for EGC are also included in other Sections.
 - 2. Some EGC mandatory and optional criteria needed to obtain EGC certification depend on product selections and may not be specifically identified as EGC requirements in this Section. Compliance with requirements needed to obtain EGC mandatory and optional criteria may be used as one criterion to evaluate substitution requests and comparable product requests.
- B. Related Requirements:
 - 1. Attachment 01 81 13.1, "2020 Enterprise Green Communities Criteria Checklist"
 - 2. Attachment 01 81 13.2, "National Program Requirements, ENERGY STAR Multifamily New Construction, Version 1.1"
 - 3. Attachment 01 81 13.3, "National Rater Design Review Checklist, ENERGY STAR Multifamily New Construction, Version 1.1"
 - 4. Attachment 01 81 13.4, "National HVAC Design Report, ENERGY STAR Multifamily New Construction, Version 1.1"
 - 5. Attachment 01 81 13.5, "National Rater Field Checklist, ENERGY STAR Multifamily New Construction, Version 1.1"
 - 6. Attachment 01 81 13.6, "National HVAC Functional Testing Checklist, ENERGY STAR Multifamily New Construction, Version 1.1"
 - 7. Attachment 01 81 13.7, "National Water Management System Requirements, ENERGY STAR Multifamily New Construction, Version 1.1"
 - 8. Attachment 01 81 13.8, "Contractor, Subcontractor, and Consultant Education Plan."

1.3 DEFINITIONS

- A. EGC Verifier: Professional consultant for this project who provides guidance, verification, testing, and program communication to assist this project in achieving EGC certification.

- B. VOC: Volatile Organic Compounds are a class of chemicals that are volatile (evaporate easily) and are organic compounds (contain carbon atoms). Some common VOCs include acetone and automotive gasoline.

1.4 REFERENCE STANDARDS

- A. 2020 Enterprise Green Communities Criteria, 15th Anniversary Edition.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect or EGC Verifier about aspects of EGC mandatory criteria and optional criteria that are Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures, until the EGC program has made final determination on Project's EGC certification application.

1.6 SUBMITTALS

- A. Submit information required in this Section as well as information required in other Sections related to the requirements of the EGC mandatory criteria and optional criteria listed in this Section, and in Attachment 01 81 13.1, "2020 Enterprise Green Communities Criteria Checklist."

1.7 QUALITY ASSURANCE

- A. Perform work in accordance with the 2020 Enterprise Green Communities Criteria, 15th Anniversary Edition, for mandatory criteria and optional criteria listed in this Section and in Attachment 01 81 13.1, "2020 Enterprise Green Communities Criteria Checklist."
- B. Monitor closely any requests for substitution for products that are related to EGC mandatory criteria and optional criteria. Unless reviewed thoroughly, substitutions may jeopardize project's ability to obtain certification.
- C. Cooperate and coordinate with the EGC Verifier for implementation of testing, verification, and documentation related to EGC mandatory criteria and optional criteria.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Provide products and procedures necessary to obtain points for the EGC mandatory and optional criteria indicated as Contractor's responsibility. Although other sections specify items that contribute to these EGC criteria, Contractor shall provide additional materials and procedures necessary to meet the requirements of the EGC criteria listed in this Section and in Attachment 01 81 13.1, "2020 Enterprise Green Communities Criteria Checklist."

PART 3 - EXECUTION: EGC MANDATORY AND OPTIONAL CRITERIA (see enclosed EGC checklist for more information)

3.1 INTEGRATIVE PROCESS

- A. Mandatory Criterion 1.1 – Project Priorities Survey: Provided by others.
- B. Mandatory Criterion 1.2 – Charrettes and Coordination Meetings: Provided by others.
- C. Mandatory Criterion 1.3 – Documentation: Provided by others.
- D. Mandatory Criterion 1.4 – Construction Management:
 - 1. Contractor and invited subcontractors shall attend a meeting to review and discuss Attachment 01 81 13.8, “Contractor, Subcontractor, and Consultant Education Plan.”
 - 2. During each regularly-scheduled jobsite meeting, Contractor shall provide a status update on progress toward satisfying requirements of the EGC criteria that are listed as “Yes” or “Maybe” on Attachment 01 81 13.1, “2020 Enterprise Green Communities Criteria Checklist.”
 - 3. Include all on-site testing and verification activities required by EGC in the written overall construction schedule.

3.2 LOCATION + NEIGHBORHOOD FABRIC

- A. Mandatory Criterion 2.1 – Sensitive Site Protection: Provided by others.
- B. Mandatory Criterion 2.2 – Connections to Existing Development and Infrastructure: Provided by others.
- C. Mandatory Criterion 2.3 – Compact Development: Provided by others.
- D. Optional Criterion 2.4 – Compact Development: Provided by others.
- E. Mandatory Criterion 2.5 – Proximity to Services and Community Resources: Provided by others.
- F. Optional Criterion 2.7 – Preservation of and Access to Open Space: Provided by others.
- G. Mandatory Criterion 2.8 – Access to Transit: Provided by others.
- H. Optional Criterion 2.14 – Local Economic Development and Community Wealth Creation
 - 1. Demonstrate that a local preference for construction employment and subcontractor hiring was part of the bidding process.
 - a. “Local preference” is defined as preference for any individual who resides within 25 miles of the project site.
 - b. Indian preference does not contain a “miles to project” requirement.

3.3 SITE IMPROVEMENTS

- A. Mandatory Criterion 3.1 – Environmental Remediation: Provided by others.
- B. Mandatory Criterion 3.2 – Minimization of Disturbance during Staging and Construction
 - 1. Implement U.S. Environmental Protection Agency (EPA)’s National Pollutant Discharge Elimination System (NPDES)’s Stormwater Discharges from Construction Activities guidance, or local requirements, whichever is more stringent, as determined by the Architect.
- C. Mandatory Criterion 3.3 – Ecosystem Services/Landscape
 - 1. If providing plantings, all plantings (trees, shrubs, and groundcover, including grasses) shall be native or climate-appropriate (adapted) to the region.
 - 2. All new plantings must be appropriate to the Project site’s soil and microclimate.
 - 3. No invasive plant species shall be introduced.
 - 4. All disturbed areas shall be planted, seeded, or xeriscaped.
- D. Mandatory Criterion 3.4 – Surface Stormwater Management
 - 1. Treat or retain, on-site, the precipitation volume from the 60th percentile precipitation event as defined by the U.S. Environmental Protection Agency in the Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act.
 - 2. On sites within which retaining the precipitation volume from the 60th percentile precipitation event is not feasible due to geotechnical issues (e.g. high groundwater elevations, contamination, underground utilities, underground transportation networks), soil conditions (e.g. clay soils), or the size of the site (e.g. zero lot line), treat or retain, on-site, the maximum possible precipitation volume, up to the precipitation volume from the 60th percentile precipitation event.
- E. Mandatory Criterion 3.6 – Efficient Irrigation and Water Reuse
 - 1. Install an efficient irrigation system, including the following:
 - a. Comply with all local watering restrictions.
 - b. Design irrigation zones to respond to weather considerations (temperatures, precipitation, wind), solar exposure, reflected light/heat from adjacent building or hardscape, soil type, topography/slope, plant material.
 - c. Establish irrigation volume and frequency per zone to be appropriate for the climate, soil type, and plants.
 - d. Select emission devices (e.g. spray sprinklers), valves, pipes, controllers, and sensors suitable to the landscape requirements that will facilitate long-term reliability and serviceability.
 - e. Irrigation system shall create no overspray onto impervious surfaces or adjacent planting areas. Prevent runoff of water from the site.
 - f. Install timer/controller that activates the valves for each watering zone at the best time of day to minimize evaporative losses while maintaining healthy plants, and obeying local regulations and water-use guidance.

- g. Install one soil moisture sensor controller per vegetation zone (based on irrigation demand), or rain delay controller.
 - 1. The above irrigation requirements are only required for permanent landscaping that requires regular irrigation.
- F. Optional Criterion 3.7 – Efficient Irrigation and Water Reuse
- 1. Install an efficient irrigation system equipped with a WaterSense labeled, weather-based irrigation controller (WBIC).
 - 2. Temporary irrigation to establish new trees and plantings is allowed for a period of two years.

3.4 WATER

- A. Mandatory Criterion 4.1 – Water-Conserving Fixtures, and Optional Criterion 4.2 – Advanced Water Conservation
- 2. Do not propose substitute showerheads, lavatory faucets, kitchen faucets, toilets, clothes washers or dishwashers that use more water than those listed in the construction documents, as water-consuming fixtures for this Project are specified to limit indoor water consumption and achieve EGC points for Criteria 4.1 and 4.2.
 - 3. All installed toilets, showerheads, lavatory faucets, and kitchen faucets shall be WaterSense labeled.
- B. Optional Criterion 4.3 – Water Quality
- 4. Test water from dwelling unit faucets for the presence of lead. For testing bottles and instructions, contact an EPA approved lab. Find labs near you via this site, www.epa.gov/dwlabcert/contact-information-certification-programs-and-certified-laboratories-drinking-water#state-labs, or by calling the Safe Drinking Water Hotline at 1-800-426-4791 for the address and phone number of your state laboratory certification officer to find certified labs near you.
 - a. If lead test results are above zero, install NSF/ANSI 58 or NSF/ANSI 53 filters in all dwelling units.
 - b. If lead test results are above 10 ppb, replace all fixtures with NSF 61 certified fixtures.
- C. Optional Criterion 4.4 – Monitoring Water Consumption and Leaks
- 5. Conduct pressure-loss tests and visual inspections to determine if there are any leaks; fix any leaks found. Visual inspections shall include checking for leaks at all accessible, visible water supply connections, and valves for water-using fixtures, appliances, and equipment.
 - 6. Install a device to separately monitor water consumption in each of the following areas of the project:
 - a. A cold branch off the apartment line riser for each dwelling unit

- b. Common laundry facilities
- c. Outdoor water consumption
- d. Water consumption in any of the non-residential spaces of the project, where the property owner is responsible for paying the water utility bills.

3.5 OPERATING ENERGY

A. Mandatory Criterion 5.1a – Building Performance Standard: New Construction

1. This project is pursuing certification under the ENERGY STAR Multifamily New Construction program (MFNC), using that program’s ERI path, as the method to fulfill this mandatory EGC criterion.
 - a. Comply with all of MFNC’s Contractor procedural and administrative requirements applicable to this project, and construct the building to comply with all of MFNC’s building attribute requirements applicable to this project.
 - b. See Attachments 01 81 13.2 through 01 81 13.7 for written documents stating all MFNC program requirements.

B. Optional Criterion 5.5b – Moving to Zero Carbon: All-Electric

1. Do not install any combustion equipment in the building. EGC provides an exception to this requirement, allowing combustion-powered emergency backup electric generators.

C. Mandatory Criterion 5.8 – Lighting

1. For all permanently installed lighting fixtures, interior and exterior, install high-efficiency lighting that is capable of meeting recommended light levels (weighted average footcandle) in the Illuminating Engineering Society Lighting Handbook, 10th edition
2. Recessed light fixtures installed as part of a building or dwelling unit air barrier shall be Insulation Contact Air-Tight (ICAT); exempt if installed entirely inside of or outside of an air barrier.
3. Lighting inside the building, but not in a dwelling unit, shall be controlled by occupancy sensors or automatic bi-level lighting controls; exempt if 24-hour consistent light levels are required by code.
4. Lighting power density in dwelling units, measured in watts/square foot, is 1.1 or less.
5. All exterior lighting shall meet the following specifications and have either motion sensor controls, integrative PV cells, photosensors, or astronomic time-clock operation to limit lighting when there is adequate daylight. Note, Dark Sky–approved “Friendly Fixture” certification automatically meets the following specifications
 - a. Luminaires shall be fully shielded emitting no light above 90 degrees (with the exclusion of incidental light reflecting from fixture housing, mounts, and pole). The luminaire’s mounting hardware shall not permit mounting in any configuration other than those maintaining full shielding. Non-residential luminaires shall have an uplight rating of U0.
 - b. Fixture shall have no sag or drop lenses, side light panels or uplight panels.
 - c. Fixture shall employ warm-toned (3000K and lower) white light sources or may employ amber light sources or filtered LED light sources.

6. Do not propose substitute light fixtures that use more electricity than those listed in the construction documents, as light fixtures for this Project are specified to limit electricity consumption and achieve EGC points for this criterion.

3.6 MATERIALS

A. Mandatory Criterion 6.4 – Healthier Material Selection

1. All interior paints, coatings, primers, and wallpaper shall have VOC content that is less than or equal to the thresholds provided by the most recent version of SCAQMD 1113 available at time of product specification.
 - a. VOC emissions for wall finish paints shall be verified as compliant with CDPH Standard Method.
 - b. All wallpaper shall contain no phthalates.
2. All interior adhesives and sealants shall have VOC content less than or equal to the thresholds provided by the most recent version of SCAQMD 1168 available at time of product specification.
3. For flooring materials,
 - a. All flooring products (whether carpet or hard surface) shall comply with CDPH emission requirements.
 - b. Flexible PVC with phthalates shall not be installed, whether the phthalates were intentionally added or added via recycled content.
 - c. Carpet shall not be installed in building entryways, laundry rooms, bathrooms, kitchens/kitchenettes, or utility rooms.
 - d. Fluid applied finish floors shall only be installed in non-occupied spaces, such as mechanical rooms
4. Fiberglass batt insulation and mineral wool batt insulation installed in this Project shall not contain any formaldehyde.
5. For composite wood products,
 - a. Plywood, particleboard, MDF installed as stand-alone materials, or as components within other installed products such as cabinets and doors, shall have formaldehyde emissions less than or equal to the thresholds established by CARB Phase 2 and/or TSCA Title IV.
 - b. All composite wood products used indoors that CARB and TSCA do not address shall have no added urea formaldehyde.

B. Mandatory Criterion 6.6 – Bath, Kitchen, Laundry Surfaces: New Construction

1. Throughout bathrooms, kitchens, and laundry rooms, install interior finish materials that
 - a. Have durable, cleanable surfaces,
 - b. Are not prone to deterioration due to moisture intrusion, and
 - c. Do not encourage mold growth.

2. Except where one-piece tub and/or shower enclosures are installed, install moisture-resistant backing materials such as cement board, fiber cement board, or equivalent per ASTM D6329 or ASTM D3273 behind tub and/or shower enclosures.

C. Mandatory and Optional Criterion 6.10 – Construction Waste Management:

1. Provide a construction waste management plan that diverts at least 75 percent of construction waste from the landfill.
2. Go beyond diverting 75 percent of construction waste from the landfill, by any combination of the following:
 - a. Recycle all cardboard construction waste,
 - b. Recycle all wood construction waste,
 - c. Recycle all drywall construction waste,
 - d. Recycle all metal construction waste,
 - e. Recycle all concrete, brick, and asphalt construction waste,
 - f. Recycle all insulation, foam and plastic construction waste,
 - g. Recycle all carpet construction waste,
 - h. Develop and implement a comprehensive efficient framing plan that minimizes all waste by design,
 - i. Limit total construction waste sent to a landfill or incinerator to less than 2.5 pounds per square foot of building area, and/or
 - j. Limit total construction waste sent to a landfill or incinerator to less than 2.5 pounds per square foot of building area.
3. See Division 01 Specification Sections for requirements related to the construction waste management and disposal requirements of this criterion.

D. Optional Criterion 6.11 – Recycling Storage

1. Provide separate bins for the collection of trash and recycling for each dwelling unit and all shared community rooms.

3.7 HEALTHY LIVING ENVIRONMENT

A. Mandatory Criterion 7.1 – Radon Mitigation: New Construction

1. Install passive radon-resistant features below the bottom floor slab,
2. Install a vertical vent pipe extending to the outdoors above the top of the building, with a junction box within 10 feet of an electrical outlet.

B. Mandatory Criterion 7.5 – Integrated Pest Management

1. Seal all wall, floor and joint penetrations with low-VOC caulk or other appropriate nontoxic sealing methods (i.e. window screens, door sweeps, escutcheon plates, elastomeric sealants, etc.) to prevent pest entry.
2. Install rodent- and corrosion-proof screens (e.g., copper or stainless steel mesh or rigid metal cloth) at all openings greater than 1/4-inch.

C. Mandatory and Optional Criterion 7.6 – Smoke-Free Policy: Provided by others.

D. Mandatory Criterion 7.7 – Ventilation: New Construction

1. In each dwelling unit, in accordance with ASHRAE 62.2-2010, install:
 - a. A local mechanical exhaust system in each bathroom,
 - b. A local mechanical exhaust system in each kitchen, and
 - c. A whole-dwelling unit mechanical ventilation system.
2. Verify and ensure that these dwelling unit ventilation system airflow rates are within either 15 CFM or 15 percent of the design airflow rates.

E. Optional Criterion 7.10 – Noise Reduction

1. Cooperate with third-party testing agent (paid by others) to implement testing of noise levels in bedrooms, to demonstrate that continuous noise is less than or equal to 30 dB LAeq and single sound events are less than or equal to 45 dB LAeq.

F. Mandatory Criterion 7.12 – Beyond ADA: Universal Design

1. In accordance with the building's design, construct the building to provide the following features that remove obstacles for occupants using wheelchairs or walkers:
 - a. 42-inch clear width at all hallways and corridors,
 - b. 32 inches clear and/or 36 inch rough opening at all patio doors, and all doors inside dwelling units, except for doors leading to rooms that are smaller than 48 inches by 48 inches of floor space, and
 - c. 60-inch diameter turning circle in kitchens and bathrooms.

3.8 OPERATIONS, MAINTENANCE, AND RESIDENT ENGAGEMENT**A. Mandatory Criterion 8.1 – Building Operations & Maintenance Manual and Plan**

1. Upon the Architect's request, provide information for the building operations & maintenance manual and plan with regard to installed items and built conditions, including but not limited to:
 - a. Manufacturer's O&M guidance for all mechanical and electrical equipment and appliances,
 - b. HVAC O&M schedules,
 - c. Manufacturer's refrigerant management information,
 - d. Manufacturer's O&M and replacement guidance for other specialized systems in the building,
 - e. Locations of mechanical, electrical, and water system shutoffs,
 - f. Manufacturer's replacement guidance for lighting systems, and
 - g. Manufacturer's O&M guidance for all domestic hot water system equipment.
2. See Division 01 Specification Sections for requirements related to operation and maintenance data, and record documents required by this criterion.

- B. Mandatory Criterion 8.2 – Emergency Management Manual
 - 1. Upon the Architect’s request, provide information for the emergency management manual with regard to startup and emergency shutdown procedures for equipment and systems in the building.
- C. Mandatory Criterion 8.3 – Resident Manual: Contractor requirements for this criterion are covered in the requirements for other criteria.
- D. Mandatory Criterion 8.4 – Walk-Throughs and Orientations to Property Operation
 - 1. See Division 01 Specification Sections for requirements related to demonstration and training activities required by this criterion.
- E. Mandatory Criterion 8.5 – Energy and Water Data Collection and Monitoring: Provided by others.



M = MANDATORY
= OPTIONAL POINTS

CRITERIA CHECKLIST

This checklist provides an overview of the technical requirements within the Enterprise Green Communities Criteria.

To achieve Enterprise Green Communities Certification, all projects must achieve compliance with the Criteria mandatory measures applicable to that construction type. **New Construction projects must also achieve at least 40 optional points, and Substantial and Moderate Rehab projects must also achieve at least 35 optional points.**

These projects that also comply with Criterion 5.2b or Criterion 5.4 will be recognized with Enterprise Green Communities Certification Plus.

1. INTEGRATIVE DESIGN

☒ YES ☐ NO ☐ MAYBE

M

1.1 Integrative Design: Project Priorities Survey

Complete the Project Priorities Survey, which can be found in the *Appendix*.

☒ YES ☐ NO ☐ MAYBE

M

1.2 Integrative Design: Charrettes and Coordination Meetings

Develop an integrative design process that moves the outputs of the Project Priorities Survey into action through a series of collaborative meetings. Prioritize multi-benefit strategies. Assign responsibility within your design and development teams for accountability.

☒ YES ☐ NO ☐ MAYBE

M

1.3 Integrative Design: Documentation

Include Enterprise Green Communities Criteria information in your contract documents and construction specifications (Division 1 Section 01 81 13 Sustainable Design Requirements) as necessary for the construction team to understand the requirements and how they will be verified. Ensure, and indicate, that the drawings and specifications have been generated to be compliant and meet the certification goals.

☒ YES ☐ NO ☐ MAYBE

M

1.4 Integrative Design: Construction Management

Create, implement, and document your contractor/subcontractor education plan to ensure that all persons working on-site fully understand their role in achieving the project objectives. Include a summary of the Project Priorities Survey (Criterion 1.1), the sustainability goals, and anticipated roles of each party in regards to the performance expected of the project. Attach and reference this training plan to Division 1 Section 01 81 13 Sustainable Design Requirements. Include timeline estimates for performance testing and verification schedules in the overall construction schedule. As relevant, review requirements for Criteria 8.1, 8.2, and 8.3, and begin populating these documents with relevant information from design and construction.

☐ YES ☒ NO ☐ MAYBE

12 or 15

1.5 Design for Health and Well-Being: Health Action Plan

Follow Steps 1–6 of the Health Action Plan framework per the full criterion. *[12 points with extra 3 points for Step 7]* This includes: 1) Commit to embedding health into the project lifecycle; 2) Partner with a project health professional; 3) Collect and analyze community health data; 4) Engage with community stakeholders to prioritize health data and strategies; 5) Identify strategies to address those health issues; 6) Create an implementation plan; and 7) Create a monitoring plan.



M = MANDATORY
= OPTIONAL POINTS

<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	10	INTEGRATIVE DESIGN <i>(continued)</i> 1.6 Resilient Communities: Multi-Hazard/Vulnerability Assessment Conduct a four-part assessment (social, physical, functional, strategy) to identify critical risk factors of your property and implement at least two sets of strategies to enable the project to adapt to, and mitigate, climate related or seismic risks. See full criterion for more guidance.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8	1.7 Resilient Communities: Strengthening Cultural Resilience Integrate community and resident participation in the development processes so that the built environment honors cultural identities, resident voices, and community histories. Option 1: Complete a Cultural Resilience Assessment OR Option 2: Convene a Cultural Advisory Group
	0	SUBTOTAL OPTIONAL POINTS
2. LOCATION + NEIGHBORHOOD FABRIC		
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	2.1 Sensitive Site Protection All projects must: <ol style="list-style-type: none"> 1. Protect floodplain functions (e.g., storage, habitat, water quality) by limiting new development within the 100-year floodplain of all types of watercourses. 2. Conserve and protect aquatic ecosystems, including wetlands and deepwater habitats, that provide critical ecosystem functions for fish, other wildlife, and people. 3. Protect ecosystem function by avoiding the development of areas that contain habitat for plant and animal species identified as threatened or endangered. 4. Conserve the most productive agricultural soils by protecting prime farmland, unique farmland, and farmland of statewide or local importance. If your site contains any of these ecologically sensitive features, follow the specific Requirements under that subheading.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	2.2 Connections to Existing Development and Infrastructure <i>(Mandatory for New Construction projects that do not qualify as Rural/Tribal/Small Town)</i> Locate the project on a site with access to existing roads, water, sewers, and other infrastructure and within or contiguous to (having at least 25% of the perimeter bordering) existing development. Connect the project to the existing pedestrian network. For sites over 5 acres, provide connections to the adjacent street network at least every 800 feet. Tie all planned bike paths to existing bike paths.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	2.3 Compact Development <i>(Mandatory for New Construction)</i> At a minimum, build to the residential density (dwelling units/acre) of the census block group where the project is located. In Rural/Tribal/Small Town locations that do not have zoning requirements: Build to a minimum net density of 5 units per acre for single-family houses; 10 units per acre for multifamily buildings, single and two-story; and 15 units per acre for multifamily buildings greater than two-stories.



M = MANDATORY
= OPTIONAL POINTS

<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	5 or 7 5	2.4 Compact Development Exceed the residential density (dwelling units/acre) of the census block group in which your project is located. Exceed by 2x for [5 points]; exceed by 3x for [7 points]. In Rural/Tribal/Small Towns that do not have zoning requirements, build to a minimum net density of 7.5 units per acre for single-family houses; 12 units per acre for multifamily buildings, single and two-story; and 20 units per acre for multifamily buildings greater than two stories. [5 points]
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	2.5 Proximity to Services and Community Resources (Mandatory for New Construction) Locate the project within a 0.5-mile walk distance of at least four, or a 1-mile walk distance of at least seven, of the listed services. For projects that qualify as Rural/Tribal/Small Town, locate the project within 5 miles of at least four of the listed services.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	2.6 Preservation of and Access to Open Space for Rural/Tribal/Small Town (Mandatory for New Construction Rural/Tribal/Small Town) Option 1: Locate the project within a 0.25-mile walk distance of dedicated public open space that is a minimum of 0.75 acres; at least 80% of which unpaved. OR Option 2: Set aside a minimum of 10% (minimum of 0.25 acres) of the total project acreage as open and accessible to all residents; at least 80% of which unpaved.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	6 max 4	2.7 Preservation of and Access to Open Space Option 1: Locate the project within a 0.25-mile walk distance of dedicated open space that is a minimum of 0.75 acres; at least 80% of which unpaved. OR Option 2: Set aside a percentage of permanent open space for use by all residents; at least 80% of which unpaved. 20% [2 points]; 35% [4 points]; 45% + written statement of preservation/conservation policy [6 points].
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M 2 2, 6, 8 6	2.8 Access to Transit (Mandatory for New Construction projects that do not qualify as Rural/Tribal/Small Town; Optional for all other project types) Mandatory: New Construction, not Rural/Tribal/Small Town Locate projects within a 0.5-mile walk distance of transit services (bus, rail and/or ferry), constituting at least 45 or more transit rides per weekday, with some type of weekend service. Optional: New Construction, not Rural/Tribal/Small Town Locate the project along dedicated bike trails or lanes (Class I, II, or IV) that lead to high-quality transit services (100 trips per day) within 3 miles. [2 points] Optional: Rehabilitation, not Rural/Tribal/Small Town Locate projects within a 0.5-mile walk distance of public transit services (bus, rail and/or ferry), constituting at least 45 or more transit rides per weekday, with some type of weekend service. [6 points] Locate the project along dedicated bike trails or lanes (Class I, II, or IV) that lead to high-quality transit services (100 trips per day) within 3 miles. [2 points] Optional: New Construction and Rehabilitation, Rural/Tribal/Small Town Locate the project within 0.5 mile walk distance of public transit services with at least 45 rides per weekday and some weekend service. OR, Install at least two charging stations for electric vehicles. OR, Locate the project with 5 miles of one of the following transit options: 1) vehicle share program; 2) dial-a-ride program; 3) employer vanpool; 4) park-and-ride; 5) public/private regional transportation.



M = MANDATORY
= OPTIONAL POINTS

LOCATION + NEIGHBORHOOD FABRIC <i>(continued)</i>		
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	2-8	2.9 Improving Connectivity to the Community Improve access to community amenities through at least one of the options incentivizing biking mobility or improving access to transit.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	5 max	2.10 Passive Solar Heating/Cooling Design and build with passive solar design, orientation, and shading that meet the guidelines specified.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	6	2.11 Adaptive Reuse of Buildings Rehabilitate and adapt an existing structure that was not previously used as housing. Design the project to adapt, renovate, or reuse at least 50% of the existing structure and envelope.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	6	2.12 Access to Fresh, Local Foods Provide residents and staff with access to fresh, local foods through one of the following options: Option 1: Neighborhood Farms and Gardens Option 2: Community-Supported Agriculture Option 3: Proximity to Farmers Market
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8	2.13 Advanced Certification: Site Planning, Design, and Management Locate building(s) within a community that is certified in LEED for Neighborhood Development, LEED for Cities and Communities, Living Community Challenge, or SITES.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	6 max 2 2	2.14 Local Economic Development and Community Wealth Creation Demonstrate that local preference for construction employment and subcontractor hiring was part of your bidding process, and how it functioned during construction. OR Demonstrate that you achieved at least 20% local employment. OR Provide physical space for small business, nonprofits, and/or skills and workforce education.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	2.15a Access to Broadband: Broadband Ready <i>(Mandatory for New Construction and Substantial Rehab Projects in Rural/Tribal/Small Town Locations)</i> Incorporate broadband infrastructure so that when broadband service comes to a community, the property can be easily connected. Include a network of mini-ducts or conduit throughout the building, extending from the expected communications access point to each network termination point in the building.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	6	2.15b Access to Broadband: Connectivity Ensure all units and common spaces in the property have broadband internet access with at least a speed of 25/3 mbs.
11		SUBTOTAL OPTIONAL POINTS



M = MANDATORY
= OPTIONAL POINTS

3. SITE IMPROVEMENTS		
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	3.1 Environmental Remediation Determine whether there are any hazardous materials present on the site through one of the four methods listed. Mitigate any contaminants found.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	3.2 Minimization of Disturbance During Staging and Construction For sites >1 acre, implement EPA's National Pollutant Discharge Elimination System Stormwater Discharges from Construction Activities guidance, or local requirements, whichever is more stringent. For sites with an area ≤1, follow guidance in full criterion.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	3.3 Ecosystem Services/Landscape <i>(Mandatory, if providing landscaping)</i> If providing plantings, all must be native or climate-appropriate (adapted) to the region and appropriate to the site's soil and microclimate. Do not introduce any invasive plant species. Plant, seed, or xeriscape all disturbed areas.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	3.4 Surface Stormwater Management <i>(Mandatory for New Construction; Mandatory for Substantial and Moderate Rehab projects if land disturbed is ≥5,000 sq.ft.)</i> Treat or retain on-site precipitation equivalent to the 60th percentile precipitation event. Where not feasible due to geotechnical issues, soil conditions, or the size of the site, treat or retain the maximum volume possible.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	10 max	3.5 Surface Stormwater Management Through on-site infiltration, evapotranspiration, and rainwater harvesting, retain precipitation volume from 70% precipitation event [6 points], 80% precipitation event [8 points], or 90% precipitation event [10 points].
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	3.6 Efficient Irrigation and Water Reuse <i>(Mandatory, if permanent irrigation is utilized)</i> If irrigation is utilized, install an efficient irrigation system per the requirements listed.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	4 or 6 4	3.7 Efficient Irrigation and Water Reuse <i>(Optional, if irrigation is utilized)</i> Meet the requirements of Criterion 3.6 AND: Option 1: Install an efficient irrigation system equipped with a WaterSense labeled weather-based irrigation controller (WBIC) OR Option 2: At least 50% of the site's irrigation satisfied by water use from the sources listed.
		SUBTOTAL OPTIONAL POINTS



M = MANDATORY
= OPTIONAL POINTS

4. WATER		
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	4.1 Water-Conserving Fixtures Reduce total indoor water consumption by at least 20% compared to baseline indoor water consumption chart. Any new toilet, showerhead, and/or lavatory faucet must be WaterSense certified. For all single-family homes and all dwelling units in buildings three stories or fewer, the supply pressure may not exceed 60 psi.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	6 max 3	4.2 Advanced Water Conservation Reduce total indoor water consumption by at least 30% compared to baseline indoor water consumption chart. Any new toilet, showerhead, and/or lavatory faucet must be WaterSense certified.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M, 3 M 8 8	4.3 Water Quality Mandatory/Optional: Mandatory for Substantial Rehabs of buildings built before 1986; Optional for all other building types: Replace lead service lines [3 points] Mandatory: For multifamily buildings with either a cooling tower, a centralized hot water system, or 10+ stories: Develop a Legionella water management program Optional: Test and remediate as indicated for lead, nitrates, arsenic, and coliform bacteria
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	4 4	4.4 Monitoring Water Consumption and Leaks Conduct pressure-loss tests and visual inspections to determine if there are leaks; fix leaks. AND Install an advanced water monitoring and leak detection system capable of identifying and shutting water off during anomalous water events. OR Install a device to separately monitor water consumption of each cold branch off the apartment line riser for each dwelling unit or each cold water riser and the domestic hot water cold water feed for each building or each toilet that allows remote monitor readings; common laundry facilities; boiler makeup water; outdoor water consumption; and water consumption in any non-residential space.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	4	4.5 Efficient Plumbing Layout and Design Store no more than 0.5 gallon of water in any piping/manifold between the fixture and the water heating source or recirculation line. No more than 0.6 gallon of water shall be collected from the fixture before a 10-degree Fahrenheit rise in temperature is observed. Recirculation systems must be demand-initiated.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	6 max	4.6 Non-Potable Water Reuse Harvest, treat, and reuse rainwater and/or greywater to meet a portion of the project's non-potable water needs: 10% reuse [3 points] ; 20% reuse [4 points] ; 30% reuse [5 points] ; 40% reuse [6 points] .
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8	4.7 Access to Potable Water During Emergencies Provide residents with ready access to potable water in the event of an emergency that disrupts normal access to potable water, including disruptions related to power outages that prevent pumping water to upper floors of multifamily buildings or pumping of water from on-site wells, per one of the three options listed.
	15	
		SUBTOTAL OPTIONAL POINTS



M = MANDATORY
= OPTIONAL POINTS

5. OPERATING ENERGY		
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	5.1a Building Performance Standard <i>(Mandatory for New Construction)</i> Certify all buildings with residential units in the project through either ENERGY STAR Multifamily New Construction, ENERGY STAR Manufactured Homes, and/or ENERGY STAR Certified Homes as relevant. AND Provide projected operating energy use intensity and projected operating building emissions intensity.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	5.1b Building Performance Standard <i>(Mandatory for Rehab)</i> Provide projected operating energy use intensity and projected operating building emissions intensity. AND Conduct commissioning for compartmentalization, insulation installation, and HVAC systems as indicated. AND one of the following options: <ul style="list-style-type: none"> • ERI Option: ≤HERS 80 for each dwelling unit. Exception for some Rehabs built before 1980. • ASHRAE Option: Energy performance of the completed building equivalent to, or better than, ASHRAE 90.1-2013 using an energy model created by a qualified energy services provider according to Appendix G 90.1-2016.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	12 max	5.2a Moving to Zero Energy: Additional Reductions in Energy Use <i>(Not available for projects using prescriptive path for Criterion 5.1a or for projects following Criterion 5.2b or 5.4.)</i> Projects in CZ 1-4A following this criterion must also comply with Criterion 7.8. Design and construct a building that is projected to be more efficient than what is required by Criteria 5.1a/b. Achieve HERS score of 5 lower than required by 5.1a/b if following ERI path for compliance OR 5% greater efficiency than required if following ASHRAE path for 5.1a/b compliance <i>[5 points]</i> . Additional 1 point for each additional 2-point decrease in HERS score required by Criteria 5.1a/b if following ERI path for compliance OR for 1% greater efficiency if following ASHRAE path for Criteria 5.1a/b, up to a maximum of 12 optional points.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	12-15	5.2b Moving to Zero Energy: Near Zero Certification <i>[Mandatory for Enterprise Green Communities Certification Plus]</i> <i>(Not available for projects following Criterion 5.2a or 5.4.)</i> Projects in CZ 1-4A following this criterion must also comply with Criterion 7.8. Certify the project in a program that requires advanced levels of building envelope performance such as DOE ZERH <i>[12 points]</i> and/or PHI Classic or PHIUS+ <i>[15 points]</i> .
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	3-6	5.3a Moving to Zero Energy: Photovoltaic/Solar Hot Water Ready <i>(Not available for projects following Criterion 5.3b or 5.4.)</i> Orient, design, engineer, wire, and/or plumb the development through the Photovoltaic Ready pathway or Solar Hot Water Ready Pathway to accommodate installation of photovoltaic (PV) or solar hot water system in the future.



M = MANDATORY
= OPTIONAL POINTS

<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8 max	<p>OPERATING ENERGY <i>(continued)</i></p> <p>5.3b Moving to Zero Energy: Renewable Energy <i>(Not available for projects following Criterion 5.3a or 5.4)</i> Install renewable energy source to provide a specified percentage of the project's estimated source energy demand. See full criterion for allowable sources.</p> <p>Option 1: For percentage of total project energy consumption provided by renewable energy.</p> <p>OR</p> <p>Option 2: For percentage of common area meter energy consumption provided by renewable energy.</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	24	<p>5.4 Achieving Zero Energy <i>[Automatic Qualification for Enterprise Green Communities Certification Plus]</i> <i>(Not available for projects following Criterion 5.2a, 5.2b, 5.3a, or 5.3b.)</i> Projects in CZ 1-4A following this criterion must also comply with Criterion 7.8. Achieve Zero Energy performance through one of the following options:</p> <p>Option 1: Certify each building in the project to DOE Zero Energy Ready Home program or PHI Plus AND Either install renewables and/or procure renewable energy, which in sum will produce as much, or more, energy in a given year than the project is modeled to consume.</p> <p>OR</p> <p>Option 2: Certify each building in the project in a program that requires zero energy performance such as PHIUS+ Source Zero, PHI Plus, PHI Premium, ILFI's Zero Energy Petal, Zero Carbon Petal, or Living Building Certification.</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	5 max	<p>5.5a Moving to Zero Carbon: All-Electric Ready <i>(Not available for projects following Criterion 5.5b)</i> Ensure the project has adequate electric service and has been designed and wired to allow for a seamless switch to electricity as a fuel source in the future for the following uses: space heating [1 point], space cooling [1 point], water heating (DHW) [1 point], clothes dryers [1 point], equipment for cooking [1 point].</p>
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	15	<p>5.5b Moving to Zero Carbon: All Electric <i>(Not available for projects following Criterion 5.5a)</i> No combustion equipment used as part of the building project; the project is all-electric.</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	<p>5.6 Sizing of Heating and Cooling Equipment <i>(Mandatory for Substantial and Moderate Rehabs that include replacement of heating and cooling equipment. Not relevant for projects following 5.1a, 5.2b, or 5.4.)</i> Size and select heating and cooling equipment in accordance with ACCA manuals J and S OR in accordance with the ASHRAE Handbook of Fundamentals</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	<p>5.7 ENERGY STAR Appliances <i>(Mandatory for Substantial and Moderate Rehabs providing appliances. Not relevant for projects following 5.1a, 5.2b, or 5.4.)</i> Install ENERGY STAR clothes washers, dishwashers, and refrigerators. If appliances will not be installed or replaced at this time, specify that at the time of installation or replacement, ENERGY STAR models must be used via Criterion 8.1 and Criterion 8.4.</p>
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	<p>5.8 Lighting <i>(Mandatory for all lighting within New Construction and Substantial Rehab projects. Mandatory for new lighting in Moderate Rehab projects.)</i> Follow the guidance for high-efficacy permanently installed lighting and other characteristics for recessed light fixtures, lighting controls, lighting power density, and exterior lighting.</p>



M = MANDATORY
= OPTIONAL POINTS

<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8	5.9 Resilient Energy Systems: Floodproofing <i>(Not relevant for Rehab projects in Special Flood Hazard Areas)</i> Conduct floodproofing of lower floors, including perimeter floodproofing (barriers/shields). Design and install building systems as specified by the full criterion so that the operation of those systems will not be grossly affected in case of a flood.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8	5.10 Resilient Energy Systems: Critical Loads Provide emergency power to serve at least three critical energy loads as described by the full criterion. Option 1: Islandable PV system OR Option 2: Efficient generator
	15	SUBTOTAL OPTIONAL POINTS
6. MATERIALS		
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8 max	6.1 Ingredient Transparency for Material Health Install products that have publicly disclosed inventories characterized and screened to 1,000 ppm or better: <ul style="list-style-type: none"> 1 point per 5 installed Declare or HPD products from at least three different product categories 1 point per 2 installed Declare or HPD products in any of these categories: adhesives, sealants, windows 1 point per each product with third-party verified HPD or third party verified Declare label 2 points per each product with third-party verified HPD or third party verified Declare label in any of these categories: adhesives, sealants, windows
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	3 max	6.2 Recycled Content and Ingredient Transparency Use building products that feature, and disclose, their recycled content. The building product must make up 75% by weight or cost of a project category for the project and be composed of at least 25% post-consumer recycled content.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	8 max	6.3 Chemical Hazard Optimization Install products that have third-party verification of optimization to 100 ppm or better per the options listed within the full criterion.
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	<div style="border: 1px solid red; border-radius: 50%; width: 20px; height: 20px; text-align: center; line-height: 20px; margin: 0 auto;">M</div> 15 max	6.4 Healthier Material Selection Select all interior paints, coatings, primers, and wallpaper; interior adhesives and sealants; flooring; insulation; and composite wood as specified. Optional points also available.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	12 max	6.5 Environmentally Responsible Material Selection Select concrete, steel, or insulation with a publicly disclosed EPD [3 points], Install a green or cool roof [3 points], use reflective paving [3 points], and/or use FSC certified wood [3 points]. Refer to criterion for specifics.



M = MANDATORY
= OPTIONAL POINTS

<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	<p>MATERIALS <i>(continued)</i></p> <p>6.6 Bath, Kitchen, Laundry Surfaces <i>(Mandatory for New Construction and Substantial Rehab. Moderate Rehabs that do not include work in the shower and tub areas are exempt from the shower and tub enclosure requirement.)</i></p> <p>Use materials that have durable, cleanable surfaces throughout bathrooms, kitchens, and laundry rooms.</p> <p>Use moisture-resistant backing materials per ASTM # D 6329 or 3273 behind tub/shower enclosures, apart from one-piece fiberglass enclosures which are exempt.</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	4 max	<p>6.7 Regional Materials</p> <p>Use products that were extracted, processed, and manufactured within 500 miles of the project for a minimum of 90%, based on weight or on cost, of the amount of the product category installed. Select any or all of these options (every two compliant materials can qualify for 1 point):</p> <ul style="list-style-type: none"> • Framing • Cladding (e.g. siding, masonry, roofing) • Flooring • Concrete/cement and aggregate • Drywall/interior sheathing
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	<p>6.8 Managing Moisture: Foundations <i>(Mandatory for all New Construction projects and all Rehab projects with either basement and/or crawl space foundations)</i></p> <p>Install capillary breaks and vapor retarders that meet specified criteria appropriate for the foundation type.</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	<p>6.9 Managing Moisture: Roofing and Wall Systems <i>(Mandatory for all Rehab projects that include deficiencies in or include replacing particular assemblies called out below. New Construction projects are considered compliant per Criterion 5.1.)</i></p> <p>Provide water drainage away from walls, window, and roofs by implementing the list of techniques.</p>
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M 6 max 2	<p>6.10 Construction Waste Management</p> <p>Develop and implement a waste management plan that reduces non-hazardous construction and demolition waste through recycling, salvaging, or diversion strategies through one of the three options. Achieve optional points by going above and beyond the requirement.</p>
<input type="radio"/> YES <input type="radio"/> NO <input checked="" type="radio"/> MAYBE	2 2 4	<p>6.11 Recycling Storage</p> <p>For projects with municipal recycling infrastructure and/or haulers, provide separate bins for the collection of trash and recycling for each dwelling unit and all shared community rooms.</p> <p>OR</p> <p>For projects without that infrastructure, advocate to the local waste hauler or municipality for regular collection of recyclables.</p>
SUBTOTAL OPTIONAL POINTS		



7. HEALTHY LIVING ENVIRONMENT					
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	7.1 Radon Mitigation (<i>Mandatory for New Construction and Substantial Rehab</i>) For New Construction in EPA Zone 1 areas, install passive radon-resistant features below the slab and a vertical vent pipe with junction box within 10 feet of an electrical outlet in case an active system should prove necessary in the future. For Substantial Rehab projects in EPA Zone 1, test before and after the retrofit and mitigate per the specified protocols.			
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	7.2 Reduce Lead Hazards in Pre-1978 Buildings <i>(Mandatory for Substantial Rehab of Buildings Constructed Before 1978)</i> Conduct lead risk assessment or inspection to identify lead hazards. Control identified lead hazards using lead abatement or interim controls, using lead-safe work practices that minimize and contain dust.			
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	7.3 Combustion Equipment For New Construction and Rehab projects: Specify power-vented or direct-vent equipment when installing any new combustion appliance for space or water heating that will be located within the conditioned space. If there are any combustion appliances within the conditioned space, install one hard-wired carbon monoxide (CO) alarm with battery backup function for each sleeping zone, placed per National Fire Protection Association (NFPA) 72. For Rehabs: If there is any combustion equipment located within the conditioned space for space or water heating that is not power-vented or direct-vent and that is not scheduled for replacement, conduct combustion safety testing prior to and after the retrofit; remediate as indicated.			
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	M	7.4 Garage Isolation <ul style="list-style-type: none"> • Provide a continuous air barrier between the conditioned space and any garage space to prevent the migration of any contaminants into the living space. Visually inspect common walls and ceilings between attached garages and living spaces to ensure that they are air-sealed before insulation is installed. • Do not install ductwork or air handling equipment for the conditioned space in a garage. • Fix all connecting doors between conditioned space and garage with gaskets or make airtight. • Install one hard-wired CO alarm with battery backup function for each sleeping zone of the project, placed per NFPA 72 unless the garage is mechanically ventilated or an open parking structure. 			
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	7.5 Integrated Pest Management Seal all wall, floor, and joint penetrations with low-VOC caulking or other appropriate nontoxic sealing methods to prevent pest entry.			
<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	M	7.6 Smoke-Free Policy (<i>Mandatory and Optional</i>) Mandatory: Implement and enforce a smoke-free policy in all common area and within a 25-foot perimeter around the exterior of all residential buildings. Lease language must prohibit smoking in these locations and provide a graduated enforcement policy. Make the smoke-free policy readily available.			
	10	Optional: Expand the policy above to include all indoor spaces in the property.			



M = MANDATORY
= OPTIONAL POINTS

<input checked="" type="radio"/> YES <input type="radio"/> NO <input type="radio"/> MAYBE	<div style="border: 1px solid red; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">M</div> <div style="text-align: center; margin-top: 10px;">12 max</div>	<p>HEALTHY LIVING ENVIRONMENT <i>(continued)</i></p> <p>7.7 Ventilation <i>(Mandatory for New Construction and Substantial Rehab; Optional for Moderate Rehab)</i></p> <p>For each dwelling unit in full accordance with ASHRAE 62.2-2010, install:</p> <ul style="list-style-type: none"> • A local mechanical exhaust system in each bathroom <i>[3 points if Moderate Rehab]</i> • A local mechanical exhaust system in each kitchen <i>[3 points if Moderate Rehab]</i> • A whole-house mechanical ventilation system <i>[3 points if Moderate Rehab]</i> <p>Verify these flow rates are either within +/- 15 CFM or +/- 15% of design value.</p> <p>For each multifamily building of four or more stories, in full accordance with ASHRAE 62.1-2010, install:</p> <ul style="list-style-type: none"> • A mechanical ventilation system for all hallways and common spaces <i>[3 points if Moderate Rehab]</i> <p>For all project types, in addition to the above requirements:</p> <ul style="list-style-type: none"> • All systems and ductwork must be installed per manufacturer's recommendations • All bathroom fans must be ENERGY STAR-labeled and wired for adequate run-time. • If using central ventilation systems with rooftop fans, each fan must be direct-drive and variable-speed with speed controller mounted near the fan. Fans with design CFM 300-2000 must also have an ECM motor.
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE N/A	<div style="border: 1px solid orange; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">M or 5</div>	<p>7.8 Dehumidification <i>(Mandatory for properties in Climate Zones 1A, 2A, 3A, and 4A following Criterion 5.2a, 5.2b, or 5.4. Optional for all other properties.)</i></p> <p>Option 1: Design, select, and install supplemental dehumidification equipment to keep relative humidity <60%.</p> <p>OR</p> <p>Option 2: Equip all dwelling units with dedicated space, drain, and electrical hook-ups for permanent supplemental dehumidification systems to be installed if needed and install interior RH monitoring equipment as described.</p>
<input type="radio"/> YES <input checked="" type="radio"/> NO <input type="radio"/> MAYBE	<div style="border: 1px solid green; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">3</div>	<p>7.9 Construction Pollution Management</p> <p>Option 1: Earn the EPA Indoor airPlus label</p> <p>OR</p> <p>Option 2: In all dwelling units, seal all heating, cooling, and ventilation return and supply floor ducts and returns throughout construction to prevent construction debris from entering. Flush all dwelling units after completion of construction and prior to occupancy for either 48 hours or with at least 14,000 ft³ per ft² of floor area, then replace all air handling equipment filters.</p>
<input type="radio"/> YES <input type="radio"/> NO <input checked="" type="radio"/> MAYBE	<div style="border: 1px solid red; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">3</div>	<p>7.10 Noise Reduction</p> <p>Option 1: Test and demonstrate that noise levels in bedrooms meet 30 dB LAeq (continuous) and 45 dB LMax, (single sound).</p> <p>OR</p> <p>Option 2: Provide a noise abatement plan specific to the site covering general noise mitigation techniques in accordance with 24 CFR 51B.</p> <p>OR</p> <p>Option 3: Ensure all exterior wall and party wall penetrations are sealed with acoustical sealant, all party walls and floor/ceiling assemblies have an STC rating of at least 55, and exterior windows and doors in projects near a significant exterior noise source have an STC rating of at least 35.</p>



M = MANDATORY
= OPTIONAL POINTS

☐ YES ☒ NO ☐ MAYBE

8

7.11 Active Design: Promoting Physical Activity *(All projects must comply with at least one of either Criterion 7.11, 7.12, or 7.13. Points are not available for that criterion, but, are available for projects that meet two or three of these criteria.)*

Option 1: Encouraging Everyday Stair Usage (buildings that include stairs as the only means to travel from one floor to another are not eligible for this option.) Provide a staircase that is accessible and visible from the main lobby and is visible within a 25-foot walking distance from any point in the lobby per the specifications listed. Place point-of-decision signage.

OR

Option 2: Activity Spaces. Provide on-site dedicated recreation space with exercise or play opportunities for adults and/or children that is open and accessible to all residents; see criterion for specifics.

☒ YES ☐ NO ☐ MAYBE

~~8~~

7.12 Beyond ADA: Universal Design *(All projects must comply with at least one of either Criterion 7.11, 7.12, or 7.13. Points are not available for that criterion, but, are available for projects that meet two or three of these criteria.)*

Select and implement at least one of the Options with at least three different strategies in at least 75% units.

Option 1: Create welcoming and accessible spaces that encourage equitable use and social connections.

Option 2: Create spaces that are easy and intuitive to use and navigate.

Option 3: Promote safety and create spaces that allow for human error.

Option 4: Create spaces that can be accessed and used with minimal physical effort.

Option 5: Create spaces with the appropriate size and space to allow for use, whatever the user's form of mobility, size, or posture.

☐ YES ☒ NO ☐ MAYBE

8

7.13 Healing-Centered Design *(All projects must comply with at least one of either Criterion 7.11, 7.12, or 7.13. Points are not available for that criterion, but, are available for projects that meet two or three of these criteria.)*

Select and implement at least two of the Options with at least two different strategies listed in at least 75% units.

Option 1: Provide an environment that promotes feelings of real and perceived safety.

Option 2: Create flexible spaces that allow for personalization and/or manipulation to meet individual and community needs.

Option 3: Connect residents and staff to a living landscape and the natural environment.

Option 4: Utilize art and culture in project design and programming and promote social connectedness.

13

SUBTOTAL OPTIONAL POINTS



M = MANDATORY

= OPTIONAL POINTS

8. OPERATIONS, MAINTENANCE, AND RESIDENT ENGAGEMENT☒ YES ☐ NO ☐ MAYBE

M

8.1 Building Operations & Maintenance Manual and Plan *(For all Multifamily projects)*

Develop a manual with thorough building operations and maintenance (O&M) guidance and a complementary plan. The manual and plan should be developed over the course of the project design, development, and construction stages, and should include sections/chapters addressing the list of topics.

☒ YES ☐ NO ☐ MAYBE

M

8.2 Emergency Management Manual *(For all Multifamily projects)*

Provide a manual on emergency operations targeted toward operations and maintenance staff and other building-level personnel. The manual should address responses to various types of emergencies, leading with those that have the greatest probability of negatively affecting the project. The manual should provide guidance as to how to sustain the delivery of adequate housing throughout an emergency and cover a range of topics, including but not limited to:

- communication plans for staff and residents
- useful contact information for public utility and other service providers
- infrastructure and building “shutdown” procedures
- plan for regular testing of backup energy systems, if these exist

☒ YES ☐ NO ☐ MAYBE

M

8.3 Resident Manual

Provide a guide for homeowners and renters that explains the intent, benefits, use, and maintenance of their home’s green features and practices. The Resident Manual should encourage green and healthy activities per the list of topics.

☒ YES ☐ NO ☐ MAYBE

M

8.4 Walk-Throughs and Orientations to Property Operation

Provide a comprehensive walk-through and orientation for all residents, property manager(s), and buildings operations staff.

☒ YES ☐ NO ☐ MAYBE

M

8.5 Energy and Water Data Collection and Monitoring

For rental properties, upload project energy and water performance data in an online utility benchmarking platform annually for at least five years from time of construction completion per one of the four methods provided; grant Enterprise view access for that period. For owner-occupied units, collect and monitor utility data in a manner that allows for easy access and review.

0

SUBTOTAL OPTIONAL POINTS

62**TOTAL OPTIONAL POINTS**



National Program Requirements

ENERGY STAR Multifamily New Construction, Version 1 / 1.1 / OR-WA 1.2 (Rev. 02)

Eligibility Requirements

The following multifamily building types are eligible to participate in the ENERGY STAR Multifamily New Construction program:

- Any multifamily building with dwelling or sleeping units that is NOT a two-family dwelling ¹; OR
- Mixed-use buildings, where dwelling units and common space exceed 50% of the building square footage. Parking garage square footage is excluded from this calculation ²; OR
- Townhouses, if following the requirements listed in Footnote 3. ³

Townhouses are also eligible to earn the ENERGY STAR through the ENERGY STAR Single-Family New Homes program, which is a certification program for single-family detached homes and two-family dwellings.¹ For more information, visit: www.energystar.gov/newhomesrequirements. In addition, multifamily buildings with permit dates prior to July 1, 2021, may be eligible to earn the ENERGY STAR through the Single-Family New Homes or Multifamily High Rise programs. ⁴ For more information, visit: www.energystar.gov/mfhr/eligibility.

Note that multifamily buildings in California shall follow the California Program Requirements, not these National Program Requirements. Also note that compliance with these requirements is not intended to imply compliance with all local code requirements that may be applicable to the building to be built. ⁵

Partnership, Training, and Credentialing Requirements

The following requirements must be met prior to certifying multifamily buildings:

- The Builder or Developer for the project is required to sign an ENERGY STAR Partnership Agreement and complete the online "Builder / Developer Orientation", which can be found at www.energystar.gov/homesPA.
- FT Agents must meet one of the following:
 - The HVAC installing contractor AND credentialed by an EPA-recognized HVAC Quality Installation Training and Oversight Organization (H-QUITO). An explanation of this process can be found at www.energystar.gov/eshvac; OR
 - Not the HVAC installing contractor, AND
 - Signed up online in EPA's online database as an FT Agent and watched the online FT Agent orientation, which can be found at www.energystar.gov/ftas; AND
 - Holds one of the credentials listed online here: www.energystar.gov/ftas or is a representative of the Original Equipment Manufacturer (OEM).
- Energy Rating Companies (e.g., rater companies and Providers ⁶) are required to sign an ENERGY STAR Partnership Agreement, which can be found at www.energystar.gov/homesPA, and Raters ⁷ are required to complete EPA-recognized training, which can be found at www.energystar.gov/mftraining.
- Modelers for buildings in the ASHRAE Path must sign up online in EPA's online database as a Modeler and watch the online Modeler orientation, which can be found at www.energystar.gov/ASHRAEdirectory.

ENERGY STAR Certification Process ⁸

1. The certification process offers three paths to meet the performance target. Each has varying levels of flexibility to select a custom combination of measures for each building:

- Prescriptive Path:** The units and common spaces meet or exceed all the prescriptive items in the National Rater Design Review and Field Checklists which align with the minimum requirements set in the ENERGY STAR Multifamily Reference Design, Exhibit 1. As described in Exhibit 3, buildings in states that have adopted the residential 2012, 2015, or 2018 IECC, or an equivalent code will follow Version 1.1 of the Reference Design, buildings in Oregon (OR) and Washington (WA) will follow the OR and WA Version 1.2 of the Reference Design, otherwise buildings will follow Version 1.
- ERI Path:** Each unit is equivalent in performance to the minimum requirements of the ENERGY STAR Multifamily Reference Design, Exhibit 1, as assessed through energy modeling, and the common spaces meet or exceed the prescriptive requirements in the National Rater Design Review and Field Checklists which align with the minimum requirements set in Exhibit 1. As described in Exhibit 3, buildings in states that have adopted the residential 2012, 2015, or 2018 IECC, or an equivalent code will follow Version 1.1 of the Reference Design, buildings in OR and WA will follow the OR and WA Version 1.2 of the Reference Design, otherwise buildings will follow Version 1.

An EPA-recognized Home Certification Organization (HCO)'s Approved Software Rating Tool shall automatically determine the ENERGY STAR ERI Target, which is the highest ERI value that each rated unit may achieve to earn the ENERGY STAR. ^{9, 10}

Note: The ERI path will be available for buildings that exceed five stories on October 1, 2019. After this date, Raters must use an Approved Software Rating Tool that has been updated to ANSI / RESNET / ICC Std. 301-2019 to use the ERI Path for buildings that exceed five stories.

- ASHRAE Path:** The building meets or exceeds the ASHRAE performance target, which is dependent on the commercial state energy code and baseline chosen, as described in Exhibit 4.

Projects must follow the modeling requirements in the ENERGY STAR Multifamily Simulation Guidelines.

Exception: For buildings that are PHIUS+ certified, achieving a specific source energy use of $\leq 6,500$ kWh/person per year, without renewables, is accepted in lieu of achieving the ASHRAE performance target.

All ENERGY STAR certifications are subject to the oversight of a Multifamily Oversight Organization which include HCOs or Multifamily Review Organizations (MROs). All ERI Path projects must be overseen by an HCO and all ASHRAE and Prescriptive Path projects must be overseen by an MRO. MRO information can be found at www.energystar.gov/mro.



National Program Requirements

ENERGY STAR Multifamily New Construction, Version 1 / 1.1 / OR-WA 1.2 (Rev. 02)

2. Based on the path chosen, select the efficiency measures for the building:
 - a. Prescriptive Path: Meet or exceed the prescriptive requirements specified in the National Rater Design Review and Field Checklists.
 - b. ERI Path: Meet or exceed the prescriptive requirements specified in the National Rater Design Review and Field Checklists for common spaces. Using the same software program specified in Step 1, configure the preferred set of efficiency measures for the unit to be certified and verify that the resulting ERI meets or exceeds the ENERGY STAR ERI Target, as determined in Step 1.
 - c. ASHRAE Path: Meet or exceed the prescriptive requirements specified in the National Rater Design Review and Field Checklists for common spaces. Following the Simulation Guidelines, configure the preferred set of efficiency measures for the building to be certified and verify that the resulting energy savings above the ASHRAE Baseline Building meets or exceeds the required performance target per Exhibit 4.

Exception: For buildings that are PHIUS+ certified and submitting the specific source energy use per person in lieu of meeting the ASHRAE Performance Target, calculations are done in accordance with PHIUS+ modeling protocols.

Note that, regardless of the path chosen or the measures selected, the Mandatory Requirements for All Certified Multifamily Projects in Exhibit 2 are also required and impose certain constraints on the efficiency measures selected (e.g., insulation levels, insulation installation quality, window performance, duct leakage). Furthermore, on-site power generation may not be used to meet the ENERGY STAR ERI Target or the performance target in the ASHRAE Path.

3. Upon completion of design, for ASHRAE and Prescriptive Path projects only, specific documentation is submitted to an MRO for their review and approval. These documents include the Multifamily Workbook, with applicable portions completed; the Rater Design Review Checklist, unless included in the Multifamily Workbook; the HVAC Design Report; construction documents; and for ASHRAE projects, the ASHRAE Path Calculator and either the modeling file or input and output files. For PHIUS+ certified projects choosing the alternative modeling option, documentation is provided that demonstrates achievement of the required source energy per person and pre-certification from PHIUS. For multifamily projects with multiple buildings, each building must demonstrate compliance with the program requirements, but can be documented using one Multifamily Workbook and one HVAC Design Report per project. For ASHRAE Path projects, where buildings are identical, only one set of modeling files and ASHRAE Path Calculator are required to be submitted. At the discretion of the ASHRAE modeler, connected buildings may be modeled as one building or separate buildings. MROs may choose to implement alternative design review requirements. EPA strongly recommends submitting documentation before construction; however, project teams may choose to submit the design documentation with the As-Built Submittal. For the Excel-based ASHRAE Path Calculator and Multifamily Workbook, while Partners are encouraged to always use the newest versions available online, unless otherwise specified, file updates between Program revisions will not be required. After a Program revision, project teams will be required to use the updated documents based on the enforcement timeline set for the revision.
4. Upon completion of design, multifamily buildings may be eligible for the Designed to Earn the ENERGY STAR designation. To earn this optional additional designation, follow the guidance available at www.energystar.gov/mfdees.
5. Construct the building using the measures selected in Step 2 and the Mandatory Requirements for All Certified Multifamily Projects, Exhibit 2.
6. Using a Rater, verify that all requirements have been met in accordance with the Mandatory Requirements for All Certified Multifamily Projects and with the inspection procedures for minimum rated features in ANSI / RESNET / ICC Standard 301, Appendix B.⁷

The Rater must review all items on the National Rater checklists. Raters are expected to use their experience and discretion to verify that the overall intent of each inspection checklist item has been met (i.e., identifying major defects that undermine the intent of the checklist item versus identifying minor defects that the Rater may deem acceptable).

In the event that a Rater finds an item that is inconsistent with the intent of the checklists, the building cannot earn the ENERGY STAR until the item is corrected. If correction of the item is not possible, the building cannot earn the ENERGY STAR and individual units in the multifamily building also cannot be certified. In the event that an item on a National Rater checklist cannot be inspected by the Rater, the building also cannot earn the ENERGY STAR. The only exceptions to this rule are in the Thermal Enclosure System Section of the National Rater Field Checklist, where the builder may assume responsibility for verifying a maximum of eight items and the sections of the National Rater Field Checklist where a Licensed Professional may assume responsibility for verifying the specified items. A Licensed Professional must be a Professional Engineer or Registered Architect in good standing and possess a current license. This option shall only be used at the discretion of the Rater. When exercised, the builder's and/or Licensed Professionals' responsibility will be formally acknowledged by the builder and/or Licensed Professional signing the checklist for the item(s) that they verified.

In the event that a Rater is not able to determine whether an item is consistent with the intent (e.g., an alternative method of meeting a checklist requirement has been proposed), then the Rater shall consult their Provider or MRO. If the Provider or MRO also cannot make this determination, then the Rater, Provider, or MRO shall report the issue to EPA prior to project completion at: energystarhomes@energystar.gov and will receive an initial response within 5 business days. If EPA believes the current program requirements are sufficiently clear to determine whether the intent has been met, then this guidance will be provided to the partner and enforced beginning with the building in question. In contrast, if EPA believes the program requirements require revisions to make the intent clear, then this guidance will be provided to the partner but only enforced for buildings permitted after a specified transition period after the release of the revised program requirements, typically 60 days in length.

This will allow EPA to make formal policy decisions as partner questions arise and to disseminate these policy decisions through the [Policy Record](#) and the periodic release of revised program documents to ensure consistent application of the program requirements.



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7. Upon completion of construction, the Rater is required to keep electronic or hard copies of the completed and signed National Rater checklists, the National HVAC Design Report and, when the FT Agent is not a HVAC Credentialed Contractor, the National HVAC Functional Testing Checklist. Additionally, the following steps are required:
 - a. ERI Path: submit the building / project to the HCO for final certification and follow the HCO's certification and oversight procedures (e.g. quality assurance, recordkeeping, and reporting) .
 - b. ASHRAE and Prescriptive Path: specific documentation must be submitted based on as-built conditions to an MRO for their review and approval. These documents include the Multifamily Workbook; the Rater Field Checklist, unless included in the Multifamily Workbook; the HVAC Functional Testing Checklists; construction documents; photo documentation; and for ASHRAE projects, the ASHRAE Path Calculator and either the modeling file or input and output files. For PHIUS+ certified projects choosing the alternative modeling option, documentation must be provided that demonstrates achievement of the required source energy per person and certification from PHIUS. For multifamily projects with multiple buildings, each building must demonstrate compliance with the program requirements, but can be documented using one Multifamily Workbook and one HVAC Design Report per project. For ASHRAE Path projects, where buildings are identical, only one set of modeling files and ASHRAE Path Calculator are required to be submitted. At the discretion of the ASHRAE modeler, connected buildings may be modeled as one building or separate buildings.



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Exhibit 1: ENERGY STAR Multifamily Reference Design ¹¹

The ENERGY STAR Multifamily Reference Design is the set of efficiency features modeled to determine the ENERGY STAR ERI Target for each unit pursuing certification. Therefore, while the features below are not mandatory in the units for projects pursuing the ERI Path, if they are not used then other measures will be needed to achieve the ENERGY STAR ERI Target. In addition, note that the Mandatory Requirements for All Certified Multifamily Projects, Exhibit 2, contain additional requirements such as total duct leakage limits, minimum allowed insulation levels, and minimum allowed fenestration performance. Therefore, EPA recommends that partners review the documents in Exhibit 2 prior to selecting measures.

For projects pursuing the Prescriptive Path, the following features are mandatory within the units and, as specified in the National Rater and Field Checklists, in the common spaces. For projects pursuing the ERI Path, the following features are mandatory within the common spaces as specified in the National Rater Design Review and Field Checklists.

This Exhibit is not applicable for projects pursuing the ASHRAE Path.

Common Space Applicability Notes:

When using the Reference Design for common space measures as specified in the National Rater Design Review and Rater Field Checklist, the following notes apply.

- 1) Insulation levels for common spaces in Version 1 and Version 1.1 are not the values shown in the Reference Design. They must instead meet or exceed the levels in the 2009 and 2012 IECC Commercial chapter, respectively. The required values should come from the "All Other" column and the row that corresponds to the building assembly (e.g., a building with steel-frame walls would use the value in the 'Metal framed' row).
- 2) Windows and glazed entrance doors are to meet or exceed the requirements specified for "Class AW" fenestration in the Reference Design.
- 3) All exterior and common space lighting fixtures are still subject to the efficiency requirements, even though they are not in 'ANSI / RESNET / ICC Standard 301-defined Qualifying Light Fixture Locations'. Therefore, 90% of all exterior and common space fixtures must be ENERGY STAR certified or meet the alternatives defined in the National Rater Field Checklist. This requirement applies to exterior lighting fixtures that are attached to the building, but does not apply to landscape or parking lot lighting fixtures.
- 4) Where an appliance type is not eligible for ENERGY STAR certification the appliance is exempt from this requirement. Where a bathroom faucet or aerator is not eligible for WaterSense certification, (e.g., public use lavatory faucets) the fixture is exempt from this requirement.



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Version 1: ENERGY STAR Multifamily Reference Design (See Exhibit 3 for where this is applicable)								
Hot Climates (2009 IECC Zones 1,2,3) ¹²				Mixed and Cold Climates (2009 IECC Zones 4,5,6,7,8) ¹²				
Residential Cooling Equipment (Where Provided) in Dwelling Units or Common Spaces. If not listed here, see Rater Field Checklist Exhibit X.								
• Cooling equipment modeled at the applicable efficiency levels below:								
• 14.5 SEER / 12 EER AC, • Heat pump (See Residential Heating Equipment)				• 13 SEER AC, • Heat pump (See Residential Heating Equipment)				
Residential Heating Equipment (Where Provided) in Dwelling Units or Common Spaces. If not listed here, see Rater Field Checklist Exhibit X.								
• Heating equipment modeled at the applicable efficiency levels below, dependent on fuel and system type:								
• 80 AFUE gas furnace, • 80 AFUE oil furnace, • 80 AFUE boiler, • 8.2 HSPF / 14.5 SEER / 12 EER air-source heat pump with electric or dual-fuel backup.				• 90 AFUE gas furnace, • 85 AFUE ENERGY STAR oil furnace, • 85 AFUE boiler, • Heat pump, with efficiency as follows: • CZ 4: 8.5 HSPF / 14.5 SEER / 12 EER air-source w/ electric or dual-fuel backup, • CZ 5: 9.25 HSPF / 14.5 SEER / 12 EER air-source w/ electric or dual-fuel backup, • CZ 6: 9.5 HSPF / 14.5 SEER / 12 EER air-source w/ electric or dual-fuel backup, • CZ 7-8: 3.5 COP / 16.1 EER ground-source w/ electric or dual-fuel backup.				
Envelope, Windows, & Doors								
• A radiant barrier modeled if more than 10 linear feet of ductwork are located in an unconditioned attic.				• No radiant barrier modeled.				
• Dwelling unit insulation levels modeled to 2009 IECC levels (Commercial, wood-frame) and Grade I installation per ANSI / RESNET / ICC Standard 301. For all other spaces, refer to the Common Space Applicability Notes on page 4 for insulation levels. ¹³								
Climate Zone:	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4 C & 5	CZ 6	CZ 7	CZ 8
Slab Insulation R-Value:	0	0	0	10	10	15	15	20
Slab Insulation Depth (ft):	0	0	0	2	2	2	2	2
Basement Wall Continuous Insulation R-Value:	0	0	0	7.5	7.5	7.5	10	12.5
Floor Assembly U-Factor:	0.282	0.052	0.033	0.033	0.033	0.033	0.033	0.033
Wall Assembly U-Factor:	0.089	0.089	0.089	0.089	0.064	0.051	0.051	0.036
Ceiling Assembly U-Factor:	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
• Infiltration rates modeled as follows: <0.30 CFM50/ft ² of enclosure.								
• Non-Class AW dwelling unit windows and doors modeled, as illustrated below:								
Window U-Factor:	0.60 in CZs 1,2		0.35 in CZ 3		0.32 in CZ 4		0.30 in CZs 4 C,5,6,7,8	
Window SHGC:	0.27 in CZs 1,2		0.30 in CZ 3		0.40 in CZ 4		Any in CZs 4 C,5,6,7,8	
Door U-Factor:	Opaque: 0.21		≤½ lite: 0.27				>½ lite: 0.32	
Door SHGC:	Opaque: Any		≤½ lite: 0.30				>½ lite: 0.30	
Class AW and all common space fenestration modeled to 2012 IECC levels (Commercial fenestration U-Factor requirements). ¹³								
Climate Zone:	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4 C & 5	CZ 6	CZ 7	CZ 8
Fixed Window U-Factor:	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable Window U-Factor:	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Glazed Entrance Door U-Factor:	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC	0.27	0.27	0.30	0.40	0.40	0.40	any	any
Water Heater								
• DHW equipment modeled with the following efficiency levels as applicable:								
Gas:	≤55 Gal = 0.67 EF (0.64 UEF, medium; 0.68 UEF, high-draw)				>55 Gal = 0.77 EF (0.78 UEF, medium; 0.80 UEF, high-draw)			
Electric:	0.95 EF (0.93 UEF)							
Oil:	30 Gal = 0.64 EF	40 Gal = 0.62 EF	50 Gal = 0.60 EF	60 Gal = 0.58 EF	70 Gal = 0.56 EF	80 Gal = 0.54 EF		
Thermostat & Ductwork								
• Programmable thermostat modeled.								
• Supply ducts in unconditioned attics modeled with R-8 insulation; all other ducts in unconditioned space modeled with R-6 insulation.								
• Duct leakage to outdoors modeled at the greater of ≤ 4 CFM25 per 100 ft ² of conditioned floor area or ≤ 40 CFM25.								
Lighting, Appliances & Fixtures								
• ENERGY STAR refrigerators and dishwashers modeled.								
• ENERGY STAR light bulbs or fixtures modeled in 90% of ANSI / RESNET / ICC Standard 301-defined Qualifying Light Fixture Locations. For all other spaces, refer to the Common Space Applicability Notes on page 4. ¹³								
• WaterSense bathroom faucets, bathroom aerators, and showerheads. ¹³								



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Version 1.1: ENERGY STAR Multifamily Reference Design (See Exhibit 3 for where this is applicable)								
Hot Climates (2009 IECC Zones 1,2,3) ¹²				Mixed and Cold Climates (2009 IECC Zones 4,5,6,7,8) ¹²				
Residential Cooling Equipment (Where Provided) in Dwelling Units or Common Spaces. If not listed here, see Rater Field Checklist Exhibit X.								
Cooling equipment modeled at the applicable efficiency levels below:								
15 SEER / 12 EER AC, Heat pump (See Residential Heating Equipment)				CZ 4-8: 13 SEER AC, Heat pump (See Residential Heating Equipment)				
Residential Heating Equipment (Where Provided) in Dwelling Units or Common Spaces. If not listed here, see Rater Field Checklist Exhibit X.								
Heating equipment modeled at the applicable efficiency levels below, dependent on fuel and system type:								
80 AFUE gas furnace, 80 AFUE oil furnace, 80 AFUE boiler, 8.2 HSPF / 15 SEER / 12 EER air-source heat pump with electric or dual-fuel backup.				95 AFUE ENERGY STAR gas furnace, 85 AFUE ENERGY STAR oil furnace, 90 AFUE ENERGY STAR gas boiler, 86 AFUE oil boiler, Heat pump, with efficiency as follows: CZ 4: 8.5 HSPF / 15 SEER / 12 EER air-source w/ electric or dual-fuel backup, CZ 5: 9.25 HSPF / 15 SEER / 12 EER air-source w/ electric or dual-fuel backup, CZ 6: 9.5 HSPF / 15 SEER / 12 EER air-source w/ electric or dual-fuel backup, CZ 7-8: 3.6 COP / 17.1 EER ground-source w/ electric or dual-fuel backup.				
Envelope, Windows, & Doors								
Dwelling unit insulation levels modeled to 2012 IECC levels (Commercial, wood-frame) and Grade I installation per ANSI / RESNET / ICC Standard 301. For all other spaces, refer to the Common Space Applicability Notes on page 4 for insulation levels. ¹³								
Climate Zone:	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4 C & 5	CZ 6	CZ 7	CZ 8
Slab Insulation R-Value:	0	0	0	10	10	15	15	20
Slab Insulation Depth (ft):	0	0	0	2	2	2	2	2
Basement Wall Continuous Insulation R-Value:	0	0	0	7.5	7.5	7.5	10	12.5
Floor Assembly U-Factor:	0.066	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Wall Assembly U-Factor:	0.064	0.064	0.064	0.064	0.064	0.051	0.051	0.036
Ceiling Assembly U-Factor:	0.027	0.027	0.027	0.027	0.021	0.021	0.021	0.021
Infiltration rates modeled as follows: <0.30 CFM50/ft² of enclosure.								
Dwelling unit ENERGY STAR windows and doors modeled, unless Class AW, as illustrated below:								
Window U-Factor:	0.40 in CZs 1,2		0.30 in CZ 3		0.30 in CZ 4		0.27 in CZs 5,6,7,8	
Window SHGC:	0.25 in CZs 1,2		0.25 in CZ 3		0.40 in CZ 4		Any in CZs 5,6,7,8	
Door U-Factor:	Opaque: 0.17		≤½ lite: 0.25		>½ lite: 0.30			
Door SHGC:	Opaque: Any		≤½ lite: 0.25		>½ lite: 0.25 in CZs 1,2,3; 0.40 in CZs 4,5,6,7,8			
Class AW fenestration and common spaces modeled to 2015 IgCC levels (Commercial fenestration U-Factor requirements). ¹³								
Climate Zone:	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4 C & 5	CZ 6	CZ 7	CZ 8
Fixed Window U-Factor:	0.48	0.48	0.44	0.36	0.36	0.34	0.28	0.28
Operable Window U-Factor:	0.62	0.62	0.57	0.43	0.43	0.41	0.35	0.35
Glazed Entrance Door U-Factor:	1.05	0.79	0.73	0.73	0.73	0.73	0.73	0.73
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	any	any
Water Heater								
DHW equipment modeled with the following efficiency levels as applicable:								
Gas:	≤55 Gal = 0.67 EF (0.64 UEF, medium; 0.68 UEF, high-draw)				>55 Gal = 0.77 EF (0.78 UEF, medium; 0.80 UEF, high-draw)			
Electric:	0.95 EF (0.93 UEF)							
Oil:	30 Gal = 0.64 EF	40 Gal = 0.62 EF	50 Gal = 0.60 EF	60 Gal = 0.58 EF	70 Gal = 0.56 EF	80 Gal = 0.54 EF		
Thermostat & Ductwork								
Programmable thermostat modeled. All ducts and air handlers modeled within conditioned space.								
Lighting, Appliances, & Fixtures								
ENERGY STAR refrigerators and dishwashers modeled. ENERGY STAR light bulbs or fixtures modeled in 90% of ANSI / RESNET / ICC Standard 301-defined Qualifying Light Fixture Locations. For all other spaces, refer to the Common Space Applicability Notes on page 4. ¹³ WaterSense bathroom faucets, bathroom aerators, and showerheads. ¹³								



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Oregon and Washington Version 1.2: ENERGY STAR Multifamily Reference Design (See Exhibit 3 for where this is applicable)

2012 IECC Climate Zone 4C, 5, & 6¹²

Residential Cooling Equipment (Where Provided) in Dwelling Units or Common Spaces. If not listed here, see Rater Field Checklist Exhibit X.

- Cooling equipment modeled at the applicable efficiency levels below:
- 13 SEER AC,
- Heat pump (See Residential Heating Equipment)

Residential Heating Equipment (Where Provided) in Dwelling Units or Common Spaces. If not listed here, see Rater Field Checklist Exhibit X.

- Heating equipment modeled at the applicable efficiency levels below, dependent on fuel and system type:
- 95 AFUE ENERGY STAR gas furnace,
- 85 AFUE ENERGY STAR oil furnace,
- 90 AFUE ENERGY STAR gas boiler,
- 86 AFUE oil boiler,
- 9.5 HSPF / 15 SEER / 12 EER air-source with electric or dual-fuel backup.

Envelope, Windows, & Doors

- Dwelling unit insulation levels modeled at the levels below and Grade I installation per ANSI / RESNET / ICC Standard 301. For all other spaces, refer to the Common Space Applicability Notes on page 4 for insulation levels.¹³

Above-Grade Wall	Ceiling	Floor	Basement Wall	On-Grade & Below-Grade Slab
R-21	R-49	R-38	R-15 continuous or R-21 cavity	R-10 at perimeter for entire depth of slab and under entire slab area

- Infiltration rates modeled as follows: <0.30 CFM50/ft² of enclosure.
- Non-Class AW dwelling unit windows and doors modeled, as illustrated below:

Window U-Factor:	0.27
Window SHGC:	0.30

Door U-Factor:	Opaque: 0.17	≤½ lite: 0.25	>½ lite: 0.30
Door SHGC:	Opaque: Any	≤½ lite: 0.25	>½ lite: 0.30

Class AW and all common space fenestration modeled to 2015 IgCC levels (Commercial fenestration U-Factor requirements).¹³

Climate Zone:	CZ 4 C & 5	CZ 6
Fixed Window U-Factor:	0.36	0.34
Operable Window U-Factor:	0.43	0.41
Glazed Entrance Door U-Factor:	0.73	0.73
SHGC (same as above)	0.30	0.30

Water Heater

- DHW equipment modeled with the following efficiency levels and types as applicable:
- For a home with gas or propane DHW fuel type: Tankless 0.91 EF.
- For a home with other DHW fuel type: In CZ 4C & 5¹²: Electric heat pump with 2.5 EF or 2.57 UEF; In CZ 6¹²: Electric heat pump with 2.0 EF / UEF.
- DHW piping insulation modeled: R-3.

Thermostat & Ductwork

- Programmable thermostat modeled.
- All ducts located in unconditioned space modeled with R-8 insulation.
- Duct leakage to outdoors modeled as the greater of 4 CFM25 per 100 ft² or 40 CFM25.

Lighting, Appliances, & Fixtures

- ENERGY STAR refrigerators and dishwashers modeled.
- ENERGY STAR light bulbs or fixtures modeled in 90% of ANSI / RESNET / ICC Standard 301-defined Qualifying Light Fixture Locations. For all other spaces, refer to the Common Space Applicability Notes on page 4.¹³
- WaterSense bathroom faucets, bathroom aerators, and showerheads, modeled with 2.0 gallons per minute.¹³



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Two paths are provided for satisfying the mandatory requirements for all certified projects, Exhibit 2. Track A – HVAC Grading by Rater allows a Rater to utilize ANSI / RESNET / ACCA Std. 310 ¹⁴, a standard for grading the installation of residential HVAC systems serving individual spaces and a Functional Testing Agent to verify commercial and central systems. Track B – HVAC Testing by FT Agent utilizes a Functional Testing Agent for all systems. Either path may be selected, but all requirements within that path must be satisfied for the building to be certified.

Exhibit 2: Mandatory Requirements for All Certified Multifamily Projects

Party Responsible	Mandatory Requirements
Requirements Applicable to Track A & B	
Rater	<ul style="list-style-type: none"> • Completion of National Rater Design Review Checklist • Completion of National Rater Field Checklist
Builder or Developer	<ul style="list-style-type: none"> • Completion of National Water Management System Requirements
Requirements Only Applicable to Track A – HVAC Grading by Rater ¹⁴	
HVAC System Designer	<ul style="list-style-type: none"> • Completion of an HVAC design report compliant with ANSI / ACCA / RESNET Std. 310, plus the ENERGY STAR MFNC Supplement
Functional Testing Agent	<ul style="list-style-type: none"> • Completion of applicable sections of the National HVAC Functional Testing Checklist. Exempt from Sections 2 and 3 for Dwelling Unit HVAC as the Rater is the party responsible for assessing these systems installation quality in accordance with ANSI / RESNET / ACCA Std. 310
Requirements Only Applicable to Track B – HVAC Testing by FT Agent	
HVAC System Designer	<ul style="list-style-type: none"> • Completion of National HVAC Design Report
Functional Testing Agent	<ul style="list-style-type: none"> • Completion of National HVAC Functional Testing Checklist

Mandatory Compliance Date

For the ERI and Prescriptive Paths, to determine the program Version that a multifamily building is required to be certified under, look up the location and permit date of the building in Exhibit 3. Note that the National Version 1.1 program requirements are being implemented in states that have adopted the residential 2012, 2015, or 2018 IECC, or an equivalent code. Note, as well, that regional program requirements, and associated implementation timelines, have been developed for buildings in CA, PR and USVI. The regional program requirements can be found at www.energystar.gov/mfncrequirements.

Multifamily buildings permitted prior to July 1, 2021 are permitted to participate in any of the following programs, as long as the project meets the Eligibility Requirements defined within that program: the ENERGY STAR Single-Family New Homes program, the ENERGY STAR Multifamily High Rise program, or this ENERGY STAR Multifamily New Construction Program.

Exhibit 3: ENERGY STAR Multifamily New Construction Implementation Timeline

State / Territory	Buildings Permitted ⁴ On or After This Date Must Meet the Adjacent Version	Multifamily New Construction Program Version	Revision ¹⁵
AL, AK, AZ, AR, CO, GA, GU, HI, IN, ID, KS, KY, LA, ME, MS, MO, NH, NM, NMI, NC, ND, OH, OK, SC, SD, TN, UT, VA, WV, WI, WY	07-01-2020	National Version 1	Rev. 01
	07-01-2021	National Version 1	Rev 02
CT, DC, DE, FL, IA, IL, MA, MD, MI, MN, MT, NJ, NV, NY, RI, TX, VT	07-01-2020	National Version 1.1	Rev. 01
	07-01-2021	National Version 1.1	Rev. 02
PA	07-01-2020	National Version 1	Rev. 01
	04-01-2021	National Version 1.1	Rev. 01
	07-01-2021	National Version 1.1	Rev. 02
NE	07-01-2020	National Version 1	Rev. 01



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	07-01-2021	National Version 1.1	Rev. 02
OR, WA	07-01-2020	Oregon and Washington Version 1.2	Rev. 01
	07-01-2021	Oregon and Washington Version 1.2	Rev. 02
PR, USVI	07-01-2020	National Version 1	Rev. 01
	07-01-2021	Caribbean Version 1.0	Rev. 02



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Exhibit 4: ASHRAE Path Performance Targets

Projects using the ASHRAE Path in states that have adopted as the commercial code the 2012 IECC, 2015 IECC, 2018 IECC, ASHRAE 90.1-2010, ASHRAE 90.1-2013, ASHRAE 90.1-2016, or equivalent, will be required to meet a Performance Target of 15% energy cost savings when compared to the energy code under which the building is permitted (unless otherwise noted below). All other projects must meet the national requirement of 15% over ASHRAE 90.1- 2007.

Notes and Exceptions:

- **Local Code Exception:** While local city or town codes may differ from the state code, the determination for the ENERGY STAR program is based on the commercial code adopted by the state, not the local jurisdiction. In an instance where the building is permitted under a local code that is not the same as the state code, the Performance Target is based on the state code in place. The permit application or issue date will be used to determine what state code was in place in the state. To determine the code adopted by the state and its effective date, please visit www.energycodes.gov.
- **Modeling options:** To reduce the burden of applying two different codes to a given project, projects are allowed to use alternate targets of 20% savings over ASHRAE 90.1-2007 as equivalent to 15% over ASHRAE 90.1-2010; and 25% savings over ASHRAE 90.1-2007 and 20% savings over ASHRAE 90.1-2010, as equivalent alternatives to 15% savings over ASHRAE 90.1-2013.
- **Appendix G version:** For projects pursuing performance targets based on ASHRAE 90.1-2007 or ASHRAE 90.1-2010, the project must use the Appendix G of the code corresponding to their Performance Target or Appendix G from ASHRAE 90.1-2016. Projects pursuing targets based on ASHRAE 90.1-2013 or later must use Appendix G from ASHRAE 90.1-2016. Projects using Appendix G from ASHRAE 90.1-2016 must use the ASHRAE Path Calculator_AppG2016 and Simulation Guidelines_AppG2016 available on the Guidance Documents page which can be found at www.energystar.gov/mfguidance. Projects may not use Appendix G from ASHRAE 90.1-2016 if they are using the 20% or 25% Performance Target Options. Note: Addendum bm from ASHRAE 90.1-2013 is not referenced since its content and the related excerpts that followed have been incorporated into Appendix G from ASHRAE 90.1-2016.
- **Performance Target for Projects Modeling using Appendix G from ASHRAE 90.1-2016:** Projects using this approach to meet a performance target above ASHRAE 90.1-2013 or later, must meet a target of 15% energy cost savings OR 15% source energy savings when compared to the energy code under which the building is permitted.

	Performance Target Options: Savings (%) above varying ASHRAE 90.1 Baselines			
State Code (IECC)	90.1-2007	90.1-2010	90.1-2013	90.1-2016
2009 IECC	15% ¹⁶	N/A	N/A	N/A
2012 IECC	20% ¹⁷	15% ¹⁶	N/A	N/A
2015 IECC	25% ¹⁷	20% ¹⁷	15% ¹⁸	N/A
2018 IECC	N/A	N/A	N/A	15% ¹⁸



National Program Requirements

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Footnotes:

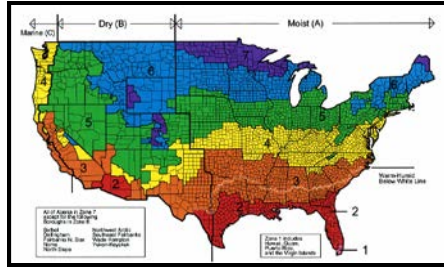
1. The term 'building' refers to a structure utilized or intended for supporting or sheltering any occupancy for a residential purpose; a structure with no dwelling or sleeping units connected to a structure with dwelling or sleeping units by less than 10% of its exterior wall area is not to be included in the 'building'. A dwelling unit, as defined by the 2012 IECC, is a single unit that provides complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation. The term 'sleeping unit' refers to a room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. The term 'two-family' dwelling refers to a detached building with 2 dwelling units. For the purposes of eligibility, hotels, motels, and [senior care facilities](#) are not considered multifamily buildings. For more information visit: https://www.energystar.gov/partner_resources/residential_new/program_reqs/mfnc_building_eligibility.
2. The term 'common space' refers to any spaces in the building being certified that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, and dining halls, as well as offices and other spaces used by building management, administration or maintenance in support of the residents.
3. The term 'townhouse' refers to a single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from the foundation to roof and with open space on at least two sides. Townhouses earning the ENERGY STAR through the Multifamily New Construction program must use the program documents described in Exhibit 2. They also must use the ERI Path of the Multifamily New Construction program as they are not eligible to use the Prescriptive Path or ASHRAE Path. However, the ENERGY STAR ERI Target for townhouses must be determined using Exhibit 1 of the relevant ENERGY STAR [Single-Family New Homes](#) National Program Requirements.
4. The Rater ⁷ may define the 'permit date' as either the date that the permit was issued or the application date of the permit. In cases where permit or application dates are not available, Providers ⁶ or Multifamily Oversight Organizations have discretion to estimate permit dates based on other construction schedule factors. These assumptions should be both defensible and documented.
5. While certification will result in compliance with many code requirements, a Rater is not responsible for ensuring that all code requirements have been met prior to certification. For more information about how these program requirements help satisfy code requirements, visit: www.energystar.gov/newhomesguidance. In the event that a code requirement, a manufacturer's installation instructions, or an engineering document conflicts with a requirement of the ENERGY STAR program (e.g., slab insulation is prohibited to allow visual access for termite inspections), then the conflicting requirement within these program requirements shall not be met. Certification shall only be allowed if the Rater has determined that no equivalent option is available that could meet the intent of the conflicting requirement (e.g., switching from exterior to interior slab edge insulation). Note that a dwelling unit must still meet its ENERGY STAR ERI Target. Therefore, other efficiency measures may be needed to compensate for the omission of the conflicting requirement.
6. The term 'Provider' refers to an Approved Rating Provider as defined by ANSI / RESNET / IECC Standard 301 that is a designee of an HCO.
7. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater, Approved Inspector, as defined by ANSI / RESNET / IECC Standard 301, or an equivalent designation as determined by a HCO or MRO; and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/mftraining.
Raters who operate under an MRO or an HCO Sampling Protocol are permitted to verify the minimum rated features of the building and to verify any Checklist Item designated "Rater Verified" using an HCO-approved sampling protocol. Where a sampling protocol does not sufficiently describe methodology for multifamily projects, use the *RESNET Guidelines for Multifamily Energy Ratings*, available at www.resnet.us/blog/resnet-adopts-guidelines-for-multifamily-energy-ratings/. No parties other than Raters are permitted to use sampling, with the exception of the Functional Testing Checklist. Functional Testing Agents, except the installing contractor, may follow the sampling protocol described in the MFNC Functional Testing Checklist Sampling Guidance document. All other items shall be verified for each certified building. For example, no builder verified items are permitted to be verified using a sampling protocol.
8. These requirements apply to all dwelling units, sleeping units, common spaces ², and garages (open or enclosed) in the building being certified, and where specified, parking lots. These requirements do not apply to commercial or retail spaces. These requirements do not apply to common spaces that are located in buildings on the property without any dwelling or sleeping units. These requirements do not apply to parking garages or lots where the cost of the energy use of the parking garage or lot is not the responsibility of the Builder/Developer, Building Owner or Property Manager.
9. The software program shall automatically determine (i.e., without relying on a user-configured ENERGY STAR Multifamily Reference Design) this target for each rated unit by following the National Multifamily ERI Target Procedure, Version 1, 1.1 or Oregon and Washington Version 1.2, based on location, available at www.energystar.gov/mfncrequirements.
10. Home Certification Organizations (HCOs) are independent organizations recognized by EPA to implement an ENERGY STAR certification program for single-family and multifamily homes and apartments using an Energy Rating Index (ERI) compliance path. Learn more and find a current list of HCOs at www.energystar.gov/partner_resources/residential_new/working/other_participants/hco.
11. Note that the efficiency levels of ENERGY STAR certified products aligned with these product specifications when this Version was first released. These efficiency features form the basis of the ENERGY STAR ERI target, regardless of any subsequent revisions to ENERGY STAR certified product specifications. EPA recommends, but does not require, that current ENERGY STAR products be included in ENERGY STAR buildings. For current ENERGY STAR products, visit www.energystar.gov/products.



National Program Requirements

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12. The following map illustrates the Climate Zone boundaries as defined by the 2009 and 2012 IECC Figure R301.1.



13. When using the Reference Design for common space measures as specified in the National Rater Design Review and Rater Field Checklist, first review the Common Space Applicability Notes that are included in Exhibit 1.
14. Track A – HVAC Grading by Rater shall not be used until an implementation schedule has been defined for ANSI / RESNET / ACCA Std. 310 by the HCO or MRO that the building is being certified under. Track A – HVAC Grading by Rater shall then use ANSI / RESNET / ACCA Std. 310 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is being certified under.
15. Buildings certified under Rev. 01 and Rev. 02 of the program requirements are permitted to use any version of the MFNC National HVAC Design Report.
16. Appendix G from the referenced code or from ASHRAE 90.1-2016 or may be used.
17. These Performance Target options may not be used for projects using Appendix G from ASHRAE 90.1-2016.
18. Appendix G from ASHRAE 90.1-2016 must be used.



National Rater Design Review Checklist ¹

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If pursuing Track A – HVAC Grading by Rater, complete this page. ³

Project Name: _____ Number of Units: _____ Permit Date: _____

Project Address: _____ City: _____ State: _____

1. Partnership Status

**Must
Correct**

**Rater ⁴
Verified**

1.1 Rater has verified and documented that builder or developer has an ENERGY STAR partnership agreement using www.energystar.gov/partnerlocator.

Builder name: _____ Developer name: _____

☐☐

1.2 ASHRAE Only: Rater has verified that modeler is listed in the online directory using

www.energystar.gov/ASHRAEdirectory.

Modeler name: _____ (Not required for projects in California)

☐☐

2. High-Performance Fenestration

2.1 Dwelling units:

2.1.1 Prescriptive: Specified fenestration meets or exceeds ENERGY STAR MF Reference Design requirements. ⁵

☐☐

2.1.2 ERI and ASHRAE only: Specified fenestration meets or exceeds 2009 IECC residential requirements. ⁵

☐☐

2.2 Common space: ²

2.2.1 ERI and Prescriptive: Specified fenestration meets or exceeds ENERGY STAR MF Reference Design requirements. ⁵

☐☐

2.2.2 ASHRAE only: Specified fenestration meets or exceeds 2009 IECC commercial requirements. ⁵

☐☐

3. High-Performance Insulation

3.1 Dwelling unit:

3.1.1: Prescriptive: Specified ceiling ⁶, wall ⁷, floor, and slab-on-grade insulation levels meet or exceed ENERGY STAR MF Reference Design requirements. ^{8, 9, 10}

☐☐

3.1.2: ERI and ASHRAE only: Specified ceiling ⁶, wall ⁷, floor, and slab-on-grade insulation levels meet or exceed values from the "Group R" column in the 2009 IECC Commercial chapter. ^{8, 9, 10}

☐☐

3.2 Common space: ²

3.2.1 ERI and Prescriptive: Specified ceiling ⁶, wall ⁷, floor, and slab-on-grade insulation levels meet or exceed ENERGY STAR MF Reference Design requirements. ^{8, 9, 10}

☐☐

3.2.2 ASHRAE only: Specified ceiling ⁶, wall ⁷, floor, and slab-on-grade insulation levels meet or exceed the values from the "All Other" column in the 2009 IECC Commercial chapter. ^{8, 9, 10}

☐☐

4a. Review of ANSI / RESNET / ACCA Std. 310 HVAC Design Report with ENERGY STAR MFNC Supplement

4a.1 HVAC design report(s) compliant with ANSI / RESNET / ACCA Std. 310 representing all applicable systems, with the ENERGY STAR MFNC supplement, collected for records, with no items left blank.

☐☐

4a.2 ANSI / RESNET / ACCA Std. 310 Rater Design Review Checklist completed for applicable housing type, with all items marked, "Rater Verified".

☐☐

4a.3 Prescriptive Path: Dwelling Unit Mechanical Ventilation is <150% of ASHRAE 62.2-2013 requirements. ¹¹

☐☐

4a.4 Total occupant gains do not exceed 645 Btuh per occupant. ¹²

☐☐

4a.5 Non-occupant internal gains are less than 3,600 Btuh.

☐☐

4a.6 Cooling sizing % is within the cooling sizing limit selected by the HVAC designer.

☐☐

Rater Name: _____ Date of Review: _____

Rater Signature: _____ Rater Company Name: _____



National Rater Design Review Checklist ¹

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If pursuing Track B – HVAC Testing by FT Agent, complete this page.		
Project Name: _____ Number of Units: _____ Permit Date: _____		
Project Address: _____ City: _____ State: _____		
1. Partnership Status	Must Correct	Rater ⁴ Verified
1.1 Rater has verified and documented that builder or developer has an ENERGY STAR partnership agreement using www.energystar.gov/partnerlocator . Builder name: _____ Developer name: _____	<input type="checkbox"/>	<input type="checkbox"/>
1.2 ASHRAE Only: Rater has verified that modeler is listed in the online directory using www.energystar.gov/ASHRAEdirectory . Modeler name: _____ (Not required for projects in California)	<input type="checkbox"/>	<input type="checkbox"/>
2. High-Performance Fenestration		
2.1 Dwelling units:		
2.1.1 Prescriptive: Specified fenestration meets or exceeds ENERGY STAR MF Reference Design requirements. ⁵	<input type="checkbox"/>	<input type="checkbox"/>
2.1.2 ERI and ASHRAE only: Specified fenestration meets or exceeds 2009 IECC residential requirements. ⁵	<input type="checkbox"/>	<input type="checkbox"/>
2.2 Common space: ²		
2.2.1 ERI and Prescriptive: Specified fenestration meets or exceeds ENERGY STAR MF Reference Design requirements. ⁵	<input type="checkbox"/>	<input type="checkbox"/>
2.2.2 ASHRAE only: Specified fenestration meets or exceeds 2009 IECC commercial requirements. ⁵	<input type="checkbox"/>	<input type="checkbox"/>
3. High-Performance Insulation		
3.1 Dwelling unit:		
3.1.1: Prescriptive: Specified ceiling ⁶ , wall ⁷ , floor, and slab-on-grade insulation levels meet or exceed ENERGY STAR MF Reference Design requirements. ^{8, 9, 10}	<input type="checkbox"/>	<input type="checkbox"/>
3.1.2: ERI and ASHRAE only: Specified ceiling ⁶ , wall ⁷ , floor, and slab-on-grade insulation levels meet or exceed values from the "Group R" column in the 2009 IECC Commercial chapter. ^{8, 9, 10}	<input type="checkbox"/>	<input type="checkbox"/>
3.2 Common space: ²		
3.2.1 ERI and Prescriptive: Specified ceiling ⁶ , wall ⁷ , floor, and slab-on-grade insulation levels meet or exceed ENERGY STAR MF Reference Design requirements. ^{8, 9, 10}	<input type="checkbox"/>	<input type="checkbox"/>
3.2.2 ASHRAE only: Specified ceiling ⁶ , wall ⁷ , floor, and slab-on-grade insulation levels meet or exceed the values from the "All Other" column in the 2009 IECC Commercial chapter. ^{8, 9, 10}	<input type="checkbox"/>	<input type="checkbox"/>
4b. Review of ENERGY STAR MFNC National HVAC Design Report (National HVAC Design Report Item # indicated in parenthesis) ¹³		
4b.1 National HVAC Design Report(s) collected for records, with no Items left blank.	<input type="checkbox"/>	<input type="checkbox"/>
4b.2 National HVAC Design Report(s) reviewed by Rater for the following parameters (National MFNC HVAC Design Report Item # indicated in parenthesis):		
4b.2.1 Prescriptive Path: Dwelling Unit Mechanical Ventilation (2.7) is <150% of ASHRAE 62.2-2013 requirements. ¹¹	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.2 Cooling season and heating season outdoor design temperatures used in loads (3.4) are within the limits defined for the State and County where the building will be built, or the designer has provided an allowance from EPA to use alternative values. All limits are published at www.energystar.gov/hvacdesigntemps . Note that revised (i.e., 2019 Edition) limits are required to be used for all HVAC Design Reports generated after 07/01/2020. ¹⁴	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.3 Number of occupants used in loads (3.6) is within ± 2 of the dwelling unit to be certified and total occupant gains (3.7) do not exceed 645 Btuh per occupant. ¹²	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.4 Conditioned floor area used in loads (3.8) is between 100 sq. ft. smaller and 300 sq. ft. larger than the dwelling unit to be certified. ¹⁵	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.5 Window area used in loads (3.9) is between 15 sq. ft. smaller and 60 sq. ft. larger than the dwelling unit to be certified, or for dwelling units to be certified with > 500 sq. ft. of window area, between 3% smaller and 12% larger. ¹⁶	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.6 Predominant window SHGC used in loads (3.10) is within 0.1 of predominant value in the dwelling unit to be certified. ¹⁷	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.7 Mechanical ventilation used in loads (3.12) is the same as the ventilation design (2.7) for the given unit plan.	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.8 Non-occupant internal gains (3.13) are less than 3,600 Btuh.	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.9 Sensible & total heat gain are documented (3.15, 3.17) for the orientation of the dwelling unit to be certified. ¹⁸	<input type="checkbox"/>	<input type="checkbox"/>
4b.2.10 Cooling sizing % (4.18) is within the cooling sizing limit (4.19) selected by the HVAC designer.	<input type="checkbox"/>	<input type="checkbox"/>
Rater Name: _____ Date of Review: _____		
Rater Signature: _____ Rater Company Name: _____		



National Rater Design Review Checklist ¹

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5. Additional Construction Document Review – **Recommended, not required**

5.1 Air Sealing: Review construction documents to verify that air-sealing details at assemblies adjacent to exterior and unconditioned spaces are represented which, at a minimum, demonstrate compliance with checklist items in Section 4 of the National Rater Field Checklist (noted with an asterisk below). Items 5.1.9 and 5.1.10 are not verified by the Rater in the field, but are recommended.	
5.1.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed*.	<input type="checkbox"/>
5.1.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to $\geq R-10$ in CZ 4-8*.	<input type="checkbox"/>
5.1.3 Continuous top plate or blocking is at top of walls adjoining unconditioned space including at balloon-framed parapets, and sealed*.	<input type="checkbox"/>
5.1.4 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above*.	<input type="checkbox"/>
5.1.5 Rough opening around windows & exterior doors sealed*. ¹⁹	<input type="checkbox"/>
5.1.6 Assemblies that separate attached garages from occupiable space sealed and, also, an air barrier installed, sealed, and aligned with these assemblies*. ²⁰	<input type="checkbox"/>
5.1.7 Attic access panels, roof hatches and drop-down stairs are gasketed (i.e., not caulked) or equipped with durable covers that are gasketed*. ²¹	<input type="checkbox"/>
5.1.8 Doors adjacent to unconditioned space (e.g., attics, garages, basements), ambient conditions, or a unit entrance to a corridor / stairwell, made substantially air-tight with doorsweep and weatherstripping or equivalent gasket*.	<input type="checkbox"/>
5.1.9 Above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor. Gasket also placed beneath above-grade sill plate if resting atop concrete / masonry & adjacent to conditioned space. ^{22, 23}	<input type="checkbox"/>
5.1.10 The gap between the common wall (e.g., the drywall shaft wall) and the structural framing between units sealed at all exterior boundaries.	<input type="checkbox"/>
5.2 Dwelling Unit Compartmentalization	
5.2.1 Review construction documents to verify that air-sealing details ²⁴ are represented such that air exchange between the dwelling unit and outside as well as the dwelling unit and other adjacent spaces is minimized and designed to achieve compartmentalization less than or equal to 0.30 CFM50 per square feet of dwelling unit enclosure area, following procedures in ANSI / RESNET / ICC Std. 380.	<input type="checkbox"/>
5.2.2 Seal all spaces 5.1.1-5.1.10 on adiabatic unit enclosure assemblies.	<input type="checkbox"/>
5.3 Prescriptive Path: Verify that Window-to-wall ratio $\leq 30\%$. ²⁵	<input type="checkbox"/>
5.4 Verify that fully-aligned air barrier details are in compliance with checklist items in Section 2 of the National Rater Field Checklist.	<input type="checkbox"/>
5.5 Verify that thermal bridging details are in compliance with checklist items in Section 3 of the National Rater Field Checklist.	<input type="checkbox"/>
5.6 Verify that HVAC details are in compliance with checklist items in Sections 5 - 10 of the National Rater Field Checklist.	<input type="checkbox"/>
5.6.1 Verify that HVAC design includes access and means to measure the dwelling-unit mechanical ventilation airflow rate.	<input type="checkbox"/>
5.6.2 Verify that bedrooms with design airflow ≥ 150 CFM are specified with a combination of transfer grilles, jump ducts dedicated return ducts, and/or undercut doors to achieve a Rater-measured pressure differential ≥ -5 Pa and $\leq +5$ Pa with respect to the main body of the dwelling unit when all air handlers are operating.	<input type="checkbox"/>
5.6.3 Verify that Functional Testing Agent(s) hold(s) credential required to complete the applicable sections of the National HVAC Functional Testing Checklist for all HVAC equipment in the building. For Track A, a Functional Testing Agent is not needed to complete Sections 2 and 3 for HVAC systems that will be verified and graded by the Rater. ²⁶	<input type="checkbox"/>
5.7 Verify that Domestic Hot Water, Lighting, Appliances, Plumbing Fixtures, and Whole Building Utility Data Acquisition Strategy details are in compliance with checklist items in Sections 11 – 14 of the National Rater Field Checklist.	<input type="checkbox"/>



National Rater Design Checklist Footnotes

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Footnotes:

1. This Checklist applies to all dwelling units, sleeping units, common spaces ², and garages (open or enclosed) in the building being certified, and where specified, parking lots. These requirements do not apply to parking garages or lots where the cost of the energy use of the parking garage or lot is not the responsibility of the Builder/Developer, Building Owner or Property Manager. This Checklist does not apply to commercial or retail spaces. This Checklist does not apply to common spaces that are located in buildings on the property without any dwelling or sleeping units. The term 'sleeping unit' refers to a room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Where the term 'dwelling unit' is used in this Checklist, the requirement is also required of 'sleeping' units. The term 'building' refers to a structure utilized or intended for supporting or sheltering occupancy for a residential purpose; a structure with no dwelling or sleeping units connected to a structure with dwelling or sleeping units by less than 10% of its exterior wall area is not to be included in the 'building'.
2. The term 'common space' refers to any spaces in the building being certified that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, and dining halls, as well as offices and other spaces used by building management, administration or maintenance in support of the residents.
3. Track A –HVAC Grading by Rater shall not be used until an implementation schedule has been defined for ANSI / RESNET / ACCA Std. 310 by the Home Certification Organization (HCO) or Multifamily Review Organization (MRO) that the building is being certified under. Track A –HVAC Grading by Rater shall then use ANSI / RESNET / ACCA Std. 310 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is being certified under.
4. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater, Approved Inspector, as defined by ANSI / RESNET / IECC Standard 301, or an equivalent designation as determined by a HCO or MRO; and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/mftraining.
5. All windows, doors and skylights must meet or exceed the U-factor and SHGC requirements specified in the table below. If no NFRC rating is noted on the window or in product literature (e.g., for site-built fenestration), select the U-factor and SHGC value from Tables 4 and 10, respectively, in 2013 ASHRAE Handbook of Fundamentals, Chapter 15. Select the highest U-factor and SHGC value among the values listed for the known window characteristics (e.g., frame type, number of panes, glass color, and presence of low-e coating). Note that the U-factor requirement applies to all fenestration while the SHGC only applies to the glazed portion.

	Dwelling unit doors and windows that are not classified "Class AW"*	Dwelling unit windows and doors that are classified as "Class AW" and all skylights	Common Space [†]
ERI	2009 IECC Table 402.1.1	2009 IECC Table 502.3	ENERGY STAR MF Reference Design – for Class AW
ASHRAE	2009 IECC Table 402.1.1	2009 IECC Table 502.3	2009 IECC Table 502.3
Prescriptive	ENERGY STAR MF Reference Design	Windows and Doors: ENERGY STAR MF Reference Design – for Class AW Skylights: 2012 IECC Table 402.3	ENERGY STAR MF Reference Design – for Class AW

* Classified as "Class AW" under the North American Fenestration Standard (AAMA / WDMA / CSA 101 / I.S.2 / A440).

[†] Opaque doors in common spaces in CZ1-6 shall not exceed U-0.70, and in CZ 7-8, shall not exceed U-0.5.

The following exemptions apply:

- i. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
- ii. An area-weighted average of fenestration products $\geq 50\%$ glazed shall be permitted to satisfy the SHGC requirements; and
- iii. 5% of all combined fenestration area (glazed and opaque) shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using i) and ii), above.

In PHIUS+ or PHI certified buildings, where triple-glazed window assemblies with thermal breaks / spacers between the panes are used, such windows meet the intent of Items 2.1 and 2.2 and shall be excluded when assessing compliance of i) through iii), above.

6. All insulated ceiling surfaces, regardless of slope (e.g., cathedral ceilings, tray ceilings, conditioned attic roof decks, flat ceilings, sloped ceilings), must meet the requirements for ceilings, unless the ceiling is adiabatic, such as the insulated or uninsulated ceiling between two dwelling units in a multistory building. Where the term "ceiling" is used, the component insulation levels for "roofs" shall be used.
7. Items 3.1 and 3.2 are applicable to walls that are adjacent to other buildings, the exterior, or a garage. Where the wall assembly includes continuous insulation that is interrupted by fasteners or service openings, an assembly U-factor must be calculated. For the interrupted portions, the continuous insulation cannot contribute to the assembly U-factor and an overall U-factor shall be calculated based on an area weighted ratio. Thermally broken shelf-angles are exempt from de-rating.
8. The following exceptions apply:
 - a. For ceilings with attic spaces, R-30 shall satisfy the requirement for R-38 and R-38 shall satisfy the requirement for R-49 wherever the full height of uncompressed insulation at the lower R-value extends over the wall top plate at the eaves. This exemption shall not apply if the alternative calculations in e) are used;
 - b. For ceilings without attic spaces, that are not roofs with insulation above deck, R-30 shall satisfy the requirement for any required value above R-30 if the design of the roof / ceiling assembly does not provide sufficient space for the required insulation value. This exemption shall be limited to 20% of the total insulated ceiling area. This exemption shall not apply if the alternative calculations in e) are used;
 - c. Common spaces following the ENERGY STAR Multifamily Reference Design should use the version of IECC specified and the "All Other" column of either the commercial R-value or U-factor tables. To identify the assembly insulation requirement, use the row of



National Rater Design Checklist Footnotes

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the table that best corresponds to that assembly. Unlike Prescriptive Path dwelling units, the common spaces do not need to follow the row corresponding to a wood-framed building.

- d. Where identifying insulation requirements from the commercial chapter of IECC, values from either the R-value or U-factor table may be used for compliance. When referencing the 2009 IECC, projects in Climate Zone 4 and Climate Zone 5/Marine 4 may use U-0.089 and U-0.064 respectively for Group R wood-framed walls instead of the printed U-0.064 and U-0.051.
- e. An alternative total UA calculation may also be used to demonstrate compliance, as follows:
A total building thermal envelope UA that is less than or equal to the total UA resulting from meeting the individual assembly U-factors also complies. The performance of all components (i.e., roofs, walls, floors, slabs-on-grade, and fenestration) can be traded off using the UA approach. Note that Items 1.5, 1.6, and 3.1 through 3.7 of the National Rater Field Checklist shall be met regardless of the UA tradeoffs calculated. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method.
9. Consistent with the 2009 IECC, slab edge insulation is only required for slab-on-grade floors with a floor surface less than 24 inches below grade. Slab-on-grade perimeter insulation shall extend to the top of the slab to provide a complete thermal break. If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall. Alternatively, the thermal break is permitted to be created using \geq R-3 rigid insulation on top of an existing slab (e.g., in a building undergoing a gut rehabilitation). In such cases, up to 10% of the slab surface is permitted to not be insulated (e.g., for sleepers, for sill plates). Insulation installed on top of slab shall be covered by a durable floor surface (e.g., hardwood, tile, carpet).
10. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the building, slab perimeter insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab, if the slab is in contact with the ground at that interface. Where specific details cannot meet this requirement, partners shall provide the detail to EPA to request an exemption prior to the building's certification. EPA will compile exempted details and work with industry to develop feasible details for use in future revisions to the program. A list of currently exempted details is available at: www.energystar.gov/slabeledge.
11. Raters may use this table to determine the maximum ventilation rate allowed.

Floor area	Number of Bedrooms				
	1	2	3	4	5
<500	45	57	67.5	79.5	90
501-1000	67.5	79.5	90	102	112.5
1001-1500	90	102	112.5	124.5	135
1501-2000	112.5	124.5	135	147	157.5
2001-2500	135	147	157.5	169.5	180
2501-3000	157.5	169.5	180	192	202.5
3001-3500	180	192	202.5	214.5	225
3501-4000	202.5	214.5	225	237	247.5
4001-4500	225	237	247.5	259.5	270
4501-5000	247.5	259.5	270	282	292.5

12. To determine the number of occupants among all HVAC systems in the dwelling unit, calculate the number of bedrooms, as defined below, and add one. The number of occupants used in loads must be within ± 2 of the dwelling unit to be certified.
A bedroom is defined by ANSI / RESNET / ICC Standard 301-2014 as a room or space 70 sq. ft. or greater size, with egress window and closet, used or intended to be used for sleeping. A "den", "library", or "home office" with a closet, egress window, and 70 sq. ft. or greater size or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.
An egress window, as defined in 2009 IRC Section R310, shall refer to any operable window that provides for a means of escape and access for rescue in the event of an emergency. The egress window definition has been summarized for convenience. The egress window shall:
 - have a sill height of not more than 44 inches above the floor; AND
 - have a minimum net clear opening of 5.7 sq. ft.; AND
 - have a minimum net clear opening height of 24 in.; AND
 - have a minimum net clear opening width of 20 in.; AND
 - be operational from the inside of the room without the use of keys, tools or special knowledge.
13. The Rater shall collect the National HVAC Design Report(s) per building / project. See Footnote 1 of the National HVAC Design Report for alternatives. Where using an ENERGY STAR Single-Family New Homes National HVAC Design Report, Rater must still review all Items under 4b.2. Regardless of whether the "unit-specific design", "group design", or "worst-case design" box has been checked in Item 3.2 of the National HVAC Design Report, the system design as documented on the National HVAC Design Report must fall within the tolerances in Item 4b.2 for the unit to be certified. The Rater is only responsible for verifying that the designer has not left any items blank on the National HVAC Design Report and for verifying the discrete objective parameters in Item 4b.2 of this Checklist, not for verifying the accuracy of every input on the National HVAC Design Report.
14. Visit www.energystar.gov/hvacdesigntemps for the maximum cooling season design temperature and minimum heating season design temperature permitted and the process for a designer to obtain an allowance from EPA. The same design report is permitted to be used in other counties, as long as the design temperature limits in those other counties meet or exceed the cooling and heating season temperature



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limits for the county selected. For example, if Fauquier County, VA, is used for the load calculations, with a 1% cooling temperature limit of 93 °F, then the same report could be used in Fairfax County (which has a higher limit of 94 °F) but not in Arlington County (which has a lower limit of 92 °F).

15. Conditioned Floor Area for the dwelling unit to be certified shall be calculated in accordance with the definition in ANSI / RESNET / ICC Standard 301-2019.
16. Window area for the dwelling unit to be certified shall be calculated in accordance with the on-site inspection protocol provided in Normative Appendix B of ANSI / RESNET / ICC Standard 301-2019.
17. "Predominant" is defined as the SHGC value used in the greatest amount of window area in the dwelling unit.
18. Orientation represents the direction that the front door of the dwelling unit is facing. The designer is only required to document the loads for the orientation(s) that the dwelling unit might be built in. For example, if a unit plan will only be built in a specific orientation (e.g., facing South), then the designer only needs to document the loads for this one orientation.
19. In Climate Zones 1 through 3, a continuous stucco cladding system sealed to windows and doors is permitted to be used in lieu of sealing rough openings with caulk or foam.
20. For dwelling or sleeping units adjacent to garages, EPA recommends, but does not require, carbon monoxide (CO) alarms installed in a central location in the immediate vicinity of each separate sleeping zone and according to NFPA 720.
21. Examples of durable covers include, but are not limited to, pre-fabricated covers with integral insulation, rigid foam adhered to cover with adhesive, or batt insulation mechanically fastened to the cover (e.g., using bolts, metal wire, or metal strapping).
22. Existing sill plates (e.g., in a building undergoing a gut rehabilitation) on the interior side of structural masonry or monolithic walls may not be able to complete this Item. In addition, other existing sill plates resting atop concrete or masonry and adjacent to conditioned space can in lieu of using a gasket, be sealed with caulk, foam, or equivalent material at both the interior seam between the sill plate and the subfloor and the seam between the top of the sill plate and the sheathing.
23. In Climate Zones 1 through 3, a continuous stucco cladding system adjacent to sill and bottom plates is an alternate option of sealing plates to foundation or sub-floor with caulk, foam, or equivalent material.
24. Recommended air leakage paths to be sealed include, but are not limited to the following:
 - a. Plumbing penetrations, including those from water piping, drain waste and vent piping, HVAC piping, and gas line piping.
 - b. Electrical penetrations, including those for receptacle outlets, lighting outlets / fixtures, communications wiring, thermostats, and smoke alarms.
 - c. HVAC penetrations, including those for fans and for exhaust, supply, transfer, and return air ducts.
 - d. Envelope penetrations, including at the intersection of baseboard trim and floor, at the intersection of walls and ceilings, around window trim and dwelling unit doors, including the door latch hole.
25. Window-to-Wall ratio is taken as the sum of all window area divided by the total exterior above-grade wall area. All decorative glass and skylight window area contribute to the total window area to above-grade wall ratio (WWR). Spandrel sections of curtain wall systems contribute to the above-grade wall area.
26. Functional Testing Agents must hold an approved credential, as listed at www.energystar.gov/ftas, or must be a representative of the Original Equipment Manufacturer (OEM), or a contractor credentialed by an HVAC Quality Installation Training and Oversight Organization (H-QUITO), if not completing Sections 6 and higher. Functional Testing Agents may not be the installing contractor, nor employed by the same company as the installing contractor, unless they are a credentialed contractor. An explanation of the credentialing process and links to H-QUITOs, which maintain lists of credentialed contractors, can be found at www.energystar.gov/findhvac. A directory of other FT Agents can be found at www.energystar.gov/ftas.



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HVAC Designer Responsibilities:

- Complete one National HVAC Design Report for each building which includes system design for all unique unit plans and common spaces. For projects with multiple buildings, one National HVAC Design Report per building or per project is permitted. ¹
- Obtain efficiency features (e.g., window performance, insulation levels, and infiltration rate) from the builder, architect, or Rater. ²
- Provide the completed National HVAC Design Report to the Rater and the person / company completing the National HVAC Functional Testing Checklist. ²

1. Design Overview

1.1 Designer name: _____ Designer company: _____ Date: _____
1.2 Select which party you are providing these design services to: ☐ Builder / Developer ☐ FT Agent ☐ MEP / Credentialed HVAC contractor
1.3 Name of company you are providing these design services to (if different than Item 1.1): _____
1.4 Project address: _____ City: _____ State: _____ Zip code: _____

2a. Dwelling Unit & Common Space Mechanical Ventilation Design ^{3, 4}

Designer
Verified

Airflow:

2.1 Dwelling unit ventilation airflow design rate & run-time meet the requirements of Section 4 of ASHRAE 62.2 ⁵ ☐ 2010 ☐ 2013. ☐
2.2 Common space outdoor airflow design rate meet the requirements of Section 6 of ASHRAE 62.1 ⁶ ☐ 2010 ☐ 2013, without exceeding 2013 rates by more than 50%. ☐
2.3 Access points to measure airflow rate and inspect outdoor air dampers are provided and accessible by the Rater. ² ☐

List unique unit plan for which 62.2 ventilation rates were calculated in the spaces to the right: ⁷

2.4 # of bedrooms:						
2.5 Square footage:						
2.6 Ventilation airflow rate required by ASHRAE 62.2:						
2.7 Ventilation airflow rate designed:						
2.7.1 If applicable, run-time per cycle (minutes):						
2.7.2 If applicable, cycle time (minutes):						

List common space for which 62.1 ventilation rates were calculated in the spaces to the right: ⁷

2.8 Ventilation airflow rate required by ASHRAE 62.1:						
2.9 Ventilation airflow rate designed:						

System Type & Controls:

List Ventilation System ID in the spaces to the right: ⁷						
2.10 Specified system type: (e.g., supply, exhaust, balanced, ERV, HRV)						
2.11 Specified system type: (e.g., in-unit, central)						
2.12 Manufacturer:						
2.13 Model Number:						
2.14 Area / space(s) that system serves: (e.g., Unit A kitchens, corridor, community room)						
2.15 Specified control location: (e.g., Master bath, utility):						

2.16 Specified controls allow the systems to operate automatically, without occupant intervention. A ventilation override control is specified and also labeled if its function is not obvious (e.g., a label is required for a standalone wall switch, but not for a switch that's on the ventilation equipment). In townhouses only, this control must be readily accessible to the occupant. In all other multifamily dwelling units, the override control is not required to be readily accessible to the occupant. However, in such cases, EPA recommends but does not require that the control be readily accessible to others (e.g., building maintenance staff) in lieu of the occupant. ☐

2.17 No outdoor air intakes designed to connect to the return side of the dwelling unit HVAC system, unless specified controls operate intermittently and automatically based on a timer and restrict intake when not in use (e.g., motorized damper). ⁸ ☐

Sound:

2.18 If located in the dwelling unit, the fan of the specified system is rated ≤ 3 sonas if intermittent and ≤ 2 sonas if continuous, or exempted. ⁹ ☐

Efficiency:

2.19 If system utilizes the dwelling unit HVAC fan, then the specified fan type in Item 4.12 is ECM / ICM, or the specified controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling. <input type="checkbox"/>
2.20 If in-unit bathroom fans or in-line fans are specified as part of the dwelling unit mechanical ventilation system, then they are ENERGY STAR certified. ¹⁰ <input type="checkbox"/>
2.21 If central exhaust fans, ≤ 1 HP, are specified as part of the dwelling unit mechanical ventilation system, then they are direct-drive, ECM, with variable speed controllers. If > 1 HP, they are specified with NEMA Premium™ Motors. <input type="checkbox"/>



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Air Inlet Locations: (Complete this section if system has specified air inlet location(s); otherwise check "N/A".) ¹¹						Designer Verified
						<input type="checkbox"/> N/A
2.22 Inlet(s) pull ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit.						<input type="checkbox"/>
2.23 Inlet(s) are ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and ≥ 3 ft. from dryer exhausts and sources exiting the roof.						<input type="checkbox"/>
2.24 Inlet(s) are provided with rodent / insect screen with ≤ 0.5 inch mesh.						<input type="checkbox"/>
2b. Dwelling Unit Local Mechanical Exhaust Design – System(s) are designed that mechanically exhaust air from each dwelling unit kitchen and bathroom directly to the outdoors or to ventilation risers and meet the continuous and/or intermittent rates. ¹²						<input type="checkbox"/>
Location		Continuous Rate		Intermittent Rate ¹³		Exhaust Fan Type
Kitchen	Airflow	≥ 5 ACH, based on kitchen volume ^{14, 15, 16}		≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume ^{14, 15, 16, 17}		<input type="checkbox"/> Continuous
	Sound	Recommended if in-unit: ≤ 1 sone		Recommended if in-unit: ≤ 3 sones		<input type="checkbox"/> Intermittent
						<input type="checkbox"/> In-unit fan
						<input type="checkbox"/> Central / shared fan
Bathroom	Airflow	≥ 20 CFM		≥ 50 CFM		<input type="checkbox"/> Continuous
	Sound	Required if in-unit: ≤ 2 sones		Recommended if in-unit: ≤ 3 sones		<input type="checkbox"/> Intermittent
						<input type="checkbox"/> In-unit fan
						<input type="checkbox"/> Central / shared fan
2c. Common Space and Garage Minimum Exhaust Rates – System(s) are designed that mechanically exhaust air from each common space, as required by ASHRAE 62.1-2010 or 2013						<input type="checkbox"/>
Location		ASHRAE 62.1 Rate		Design Rate		
Janitor Room		1 cfm/ft ²				
Trash / Recycling Room		1 cfm/ft ²				
Parking Garage		0.05 cfm/ft ² , standby 0.75 cfm/ft ² , full-on				<input type="checkbox"/> Shared garage exhaust fan controls include CO and NO ₂ sensors.
3. Heating & Cooling Loads						
Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces.) ²⁰ <input type="checkbox"/> N/A						
3.1 Loads calculated using: <input type="checkbox"/> Unabridged ACCA Manual J v8 <input type="checkbox"/> 2013 / 2017 ASHRAE Fundamentals <input type="checkbox"/> Other per AHJ ²¹ Townhouses only: Loads must be calculated room-by-room.						
3.2 Check one box only to indicate whether the Dwelling Unit Loads is unit-specific or represents the design of more than one unit: ²² <input type="checkbox"/> Unit-specific design <input type="checkbox"/> Group design ²³ _____ total groups for this project, representing _____ units. <input type="checkbox"/> Worst-case design (If the top floor unit with the greatest CFA and window area results in total heat gain <18 kBtuh, it may represent all other units if cooling system selected for all is single-speed & <20 kBtuh or two-speed / variable-speed & <25 kBtuh.						
3.3 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling.						<input type="checkbox"/>
3.4 Outdoor design temperatures used in loads: (See Footnote 24 and www.energystar.gov/hvacdesigntemps .) ^{22,24} County & State selected: _____ Cooling season: _____°F Heating season: _____°F						
List the unit plan for which Loads were calculated: ⁷						
3.5 Location of Unit: top, mid, bottom, corner, interior						
3.6 Number of occupants used in loads: ^{22, 25}						
3.7 Total occupant gains (Btuh): ²²						
3.8 Conditioned floor area used in loads: ^{22, 26}						
3.9 Window area used in loads: ^{22, 27}						
3.10 Predominant window SHGC used in loads: ^{22, 28}						
3.11 Infiltration (ACH / ACH50 / CFM) used in loads: ²⁹						
3.12 Mechanical ventilation (CFM) used in loads: ²²						
3.13 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): ²²						
3.14 Orientation (N, NE, E, SE, S, SW, W, NW): ²³						
3.15 Sensible Heat Gain At Design Conditions (kBtuh): ²²						
3.16 Latent Heat Gain At Design Conditions (kBtuh):						
3.17 Total Heat Gain at Design Conditions (kBtuh): ²²						
3.18 Total Heat Loss at Design Conditions (kBtuh):						
3.19 Common Space Heating & Cooling Loads ⁷						
Common Space Name: _____ Design Conditions: Total Heat Gain: _____ (kBtuh) Total Heat Loss: _____ (kBtuh)						
Common Space Name: _____ Design Conditions: Total Heat Gain: _____ (kBtuh) Total Heat Loss: _____ (kBtuh)						
Common Space Name: _____ Design Conditions: Total Heat Gain: _____ (kBtuh) Total Heat Loss: _____ (kBtuh)						



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3.20 Building Heating & Cooling Loads ⁷ (only required when shared systems such as central boilers or chillers are specified.)							Designer Verified <input type="checkbox"/> N/A																								
System Name: _____ Design Conditions: Total Heat Gain: _____ (kBtuh) Total Heat Loss: _____ (kBtuh)																															
System Name: _____ Design Conditions: Total Heat Gain: _____ (kBtuh) Total Heat Loss: _____ (kBtuh)																															
4. Heating & Cooling Equipment Selection																															
4.1 Equipment selected per <input type="checkbox"/> ACCA Manual S, or where not applicable, <input type="checkbox"/> Other: _____. (See Footnote 30) ³⁰							<input type="checkbox"/>																								
4.2 Prescriptive Path: Equipment serving dwelling units and common spaces meet the efficiency levels specified in the Exhibit X of the National Rater Field Checklist. Electric resistance space heating is not specified in dwelling units.							<input type="checkbox"/>	<input type="checkbox"/> N/A																							
4.3 ERI Path: Equipment serving common spaces but not serving dwelling units meet the efficiency levels specified in the Exhibit X of the National Rater Field Checklist. Also see Exhibit X for restrictions on electric space resistance.							<input type="checkbox"/>	<input type="checkbox"/> N/A																							
Cooling Equipment ⁷ (Complete all applicable items, noting "N/A" as needed; where the same Equipment ID is used in multiple spaces (columns), identical data is not required to be repeated and can be left blank; where cooling is not provided, check "N/A".) <input type="checkbox"/> N/A																															
List Cooling Equipment ID in the spaces to the right; duplicating as needed for each unique space served:																															
4.4 Equipment type: (e.g., PTAC / AC, Chiller / CT, PTHP / WLHP / GSHP / ASHP / VRF)																															
4.5 Area / Space(s) that system serves:																															
4.6 Chiller / condenser / outdoor unit manufacturer:																															
4.7 Chiller / condenser / outdoor unit model #:																															
4.8 Evaporator / indoor unit manufacturer:																															
4.9 Evaporator / indoor unit model #:																															
4.10 AHRI reference #: ³¹																															
4.11 AHRI listed efficiency:																															
4.12 Evaporator fan type: PSC, ECM / ICM, Other																															
4.13 Compressor speed: Single, Two, Variable																															
4.14 Turn down ratio (for variable speed equipment):																															
4.15 Latent capacity at design conditions (kBtuh): ³²																															
4.16 Sensible capacity at design conditions (kBtuh): ³²																															
4.17 Total capacity at design conditions (kBtuh): ³²																															
4.18 Cooling sizing % = Total capacity (Item 4.17) divided by Total Heat Gain (Item 3.17) of space(s) in Item 4.5: ²²																															
4.19 Meets cooling sizing limit: (see below for A, B, C, D or N/A) ²⁰																															
4.20 If "B", list Load sensible heat ratio = Max. sensible heat gain (Item 3.15) / Max. total heat gain (Item 3.17): ³³																															
4.21 If "B", calculate HDD / CDD ratio: ³³																															
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th rowspan="2" style="width: 30%;">Equipment Type & Climate Condition</th> <th colspan="3" style="text-align: center;">Compressor Type (Per Item 4.13)</th> </tr> <tr> <th style="width: 33%;">Single-Speed</th> <th style="width: 33%;">Two-Speed</th> <th style="width: 34%;">Variable-Speed</th> </tr> <tr> <td>A: For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate ³³</td> <td style="text-align: center;">Recommended: 90 – 115% Allowed: 90 – 130%</td> <td style="text-align: center;">Recommended: 90 – 120% Allowed: 90 – 140%</td> <td style="text-align: center;">Recommended: 90 – 130% Allowed: 90 – 160%</td> </tr> <tr> <td>B: For Cooling Mode of Heat Pump in Condition B Climate ³³</td> <td style="text-align: center;">90% - 100%, plus 15 kBtuh</td> <td style="text-align: center;">90% - 100%, plus 15 kBtuh</td> <td style="text-align: center;">90% - 100%, plus 15 kBtuh</td> </tr> <tr> <td>C: For low-load spaces (≤15 kBtuh) ³⁴</td> <td style="text-align: center;">≤ 20 kBtuh</td> <td></td> <td></td> </tr> <tr> <td>D: For low-load spaces (≤18 kBtuh) ³⁴</td> <td></td> <td style="text-align: center;">≤ 25 kBtuh</td> <td style="text-align: center;">≤ 25 kBtuh</td> </tr> </table>									Equipment Type & Climate Condition	Compressor Type (Per Item 4.13)			Single-Speed	Two-Speed	Variable-Speed	A: For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate ³³	Recommended: 90 – 115% Allowed: 90 – 130%	Recommended: 90 – 120% Allowed: 90 – 140%	Recommended: 90 – 130% Allowed: 90 – 160%	B: For Cooling Mode of Heat Pump in Condition B Climate ³³	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh	C: For low-load spaces (≤15 kBtuh) ³⁴	≤ 20 kBtuh			D: For low-load spaces (≤18 kBtuh) ³⁴		≤ 25 kBtuh	≤ 25 kBtuh
Equipment Type & Climate Condition	Compressor Type (Per Item 4.13)																														
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B: For Cooling Mode of Heat Pump in Condition B Climate ³³	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh																												
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Heating Equipment ⁷ (Complete all applicable items, noting "N/A" as needed; where the same Equipment ID is used in multiple spaces (columns), identical data is not required to be repeated and can be left blank; where heating is not provided, check "N/A".)							Designer Verified
							<input type="checkbox"/> N/A
List Heating Equipment ID in the spaces to the right; duplicating as needed for each unique space served:							
4.22 Electric equipment type: PTHP, WLHP, GSHP, ASHP, VRF, Boiler, Furnace, Electric Resistance							
4.23 Gas Equipment type: HW PTAC / fan coil, Gas-Fired PTAC, Boiler, Furnace							
4.24 Area / Space(s) that system serves:							
4.25 Manufacturer:							
4.26 Model Number:							
4.27 Listed efficiency:							
4.28 Equipment output capacity (kBtuh):							
4.29 Air-source heat pump output capacity (17°F) (kBtuh):							
4.30 Type of Venting: Natural Draft, Mechanically Drafted, Direct Vent ³⁵							
4.31 Furnace heating sizing % = Total capacity (Item 4.28) divided by Total Heat Loss of space(s) in Item 4.24:							
4.32 Meets furnace sizing limit: (see below for A, B, C, or N/A) ²⁰							
A: For low-load spaces (≤ 10 kBtuh), furnace output capacity is ≤ 40 kBtuh							
B: When Used for Heating Only				C: When Paired With Cooling			
100 – 400%				Recommended: 100 – 140% Allowed: 100 – 400%			
Equipment Controls							
4.33 All equipment controls below have been included where applicable in the HVAC Design.							<input type="checkbox"/>
4.34 All heating and cooling systems serving a dwelling unit shall have thermostatic controls within the dwelling unit which are not located on exterior walls. If more than one system provides heating or cooling to the same space, controls prevent simultaneous heating and cooling.							
4.34.1 Prescriptive Path: Dwelling unit thermostats are programmable.							
4.35 Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems.							
4.36 Freeze protection systems, such as heat tracing of piping and heat exchangers, including self-regulating heat tracing, and garage / plenum heaters shall include automatic controls capable of shutting off the systems when pipe wall or garage / plenum temperatures are above 40°F. Where heat tracing is specified for freeze protection, controls must be based on pipe wall temperature and a minimum of R-3 pipe insulation is also required.							
4.37 Snow- and ice-melting systems shall include automatic controls capable of shutting off the systems when the pavement temperature is above 50°F and no precipitation is falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F so that the potential for snow or ice accumulation is negligible.							
Hydronic Distribution							<input type="checkbox"/> N/A
4.38 All hydronic distribution requirements below have been included where applicable in the HVAC Design.							<input type="checkbox"/>
4.39 All terminal heating and cooling distribution equipment must be separated from the riser or distribution loop by a control valve or terminal distribution pump, so that heated or cooled fluid is not delivered to the dwelling unit distribution equipment when there is no call from the thermostat.							
4.40 Terminal units must be equipped with pressure independent balancing valves or pressure independent control valves.							
4.41 Piping of a heating or cooling system (e.g., steam, hot or chilled water, brine, refrigerant) shall be thermally insulated in accordance with ASHRAE 90.1-2007, Table 6.8.3. Construction documents must account for piping total thickness including required insulation when passing through planks or any other penetrations and shall specify that the piping must be inspected before access is covered up:							
Heating System: Pipe size: _____ inches Insulation thickness: _____ inches Pipe size: _____ inches Insulation thickness: _____ inches							
Cooling System: Pipe size: _____ inches Insulation thickness: _____ inches Pipe size: _____ inches Insulation thickness: _____ inches							
4.42 For circulating pumps serving hydronic heating or cooling systems with three-phase motors, 1 horse-power or larger, motors shall meet or exceed efficiency standards for NEMA Premium™ motors. If 5 horse-power or larger, must also be specified with variable frequency drives.							
4.43 If a variable speed pumping system is installed, system designed to prevent "dead-heading" and a method of water flow bypass is provided, such as a minimum flow bypass valve or 3-way valves on specific terminal units.							
4.44 For shared boilers, chillers, and cooling towers, temperature and pressure gauges, air eliminator, expansion tank, and check valves are clearly shown on the drawings. A complete sequence of operations for all systems indicating recommendations for all setpoints is provided.							



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5. Dwelling Unit Duct Design (Complete if heating or cooling equipment will be installed with ducts; otherwise check "N/A".)				Designer Verified
				<input type="checkbox"/> N/A
5.1 Duct system designed for the equipment selected in Section 4, per <input type="checkbox"/> ACCA Manual D <input type="checkbox"/> Other: _____ Townhouses only: Duct system must be designed per ACCA Manual D.				<input type="checkbox"/>
5.2 Room-by-room design airflows documented below (which should sum to the mode with the higher Design HVAC fan airflow). ^{7, 36, 37}				
Name of the unit plan:		Name of the unit plan:		
Design HVAC fan airflow: ³⁸ Cooling mode _____ CFM Heating mode _____ CFM		Design HVAC fan airflow: ³⁸ Cooling mode _____ CFM Heating mode _____ CFM		
Design HVAC fan speed setting (e.g., low, medium, high): ³⁹ Cooling mode _____ Heating mode _____		Design HVAC fan speed setting (e.g., low, medium, high): ³⁹ Cooling mode _____ Heating mode _____		
Design total external static pressure (corresponding to the mode with the higher airflow above): ⁴⁰ _____ IWC		Design total external static pressure (corresponding to the mode with the higher airflow above): ⁴⁰ _____ IWC		
Room Name		Design Airflow (CFM)		
1		1		
2		2		
3		3		
4		4		
5		5		
6		6		
7		7		
8		8		
9		9		
10		10		
Total for all rooms		Total for all rooms		
6. Duct Quality Installation - Applies to Heating, Cooling, Ventilation, Exhaust, & Pressure Balancing Ducts, Unless Noted in Footnote				
6.1 All duct quality installation requirements below have been included where applicable in the HVAC Design.				<input type="checkbox"/>
6.2 Ductwork specified without kinks, sharp bends, compressions, or excessive coiled flexible ductwork. ⁴¹				
6.3 All supply and return ducts not in conditioned space, including connections to trunk ducts, are insulated to \geq R-6. ⁴²				
6.3.1 Prescriptive Path: Dwelling unit ductwork meets the location and insulation requirements specified in the ENERGY STAR MF Reference Design.				
Dwelling Unit				
6.4 MERV 6+ filter(s) specified for each ducted mech. system serving an individual dwelling unit and located to facilitate access & regular service by the occupant or building owner. Filter access panel specified with a gasket or comparable sealing mechanism. All return air and mechanically supplied outdoor air designed to pass through filter prior to conditioning.				
6.5 Ductwork air-sealing specified such that Rater-measured total duct leakage is \leq 4 CFM25 per 100 ft ² of CFA at rough-in or \leq 8 CFM25 per 100 ft ² at final, or if there are no ducted returns, \leq 3 CFM25 per 100 ft ² of CFA at rough-in or \leq 6 CFM25 per 100 ft ² at final. ⁴³ Additionally, for Townhouses only, Rater-measured duct leakage to the outside is \leq 4 CFM25 per 100 ft ² of CFA or \leq 40 CFM25. ⁴⁴				
6.6 Bedrooms with a design supply airflow \geq 150 CFM (as reported in Item 5.2) are specified with any combination of transfer grilles, jump ducts, dedicated return ducts, and/or undercut doors to achieve a Rater-measured pressure differential \geq - 5 Pa and \leq 5 Pa with respect to the main body of the dwelling unit when all air handlers are operating.				
Common Space				
6.7 Duct design specifies that all supply, return, and exhaust ductwork and all plenums serving common spaces shall be sealed at all transverse joints, longitudinal seams, and duct wall penetrations.				
6.8 Central exhaust systems (that serve four or more dwelling units): Ductwork air-sealing specified such that measured duct leakage does not exceed 25% of exhaust fan flow at rough-in (e.g., including trunks, branches, and take-offs) or 30% of exhaust fan flow at final (e.g., inclusive of all ductwork between the fan and the grilles). ⁴⁵				



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Footnotes:

1. This report shall represent system design for all unique unit plans, common spaces, and where applicable, parking garages. The term 'common space' refers to any spaces in the building being certified that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, and dining halls, as well as offices and other spaces used by building management, administration or maintenance in support of the residents. As an alternative, for dwelling units, project teams may instead choose to complete a Single-Family New Homes National HVAC Design Report for each unique unit plan. For those unit plans, Items 3.7 and 3.13 of this Report would still need to be completed. Sections 4 and 5 must be completed in either Design Report unless exempted by this Report. All other systems, including all systems serving common spaces, must be documented in this Design Report. This report is designed to meet ASHRAE 62.1-2010 / 2013, ASHRAE 62.2-2010 / 2013, and ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new multifamily buildings when compared to multifamily buildings built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems (e.g., those caused by a lack of maintenance or occupant behavior). Therefore, system designs documented through the use of this report are not a guarantee of proper ventilation, indoor air quality, or HVAC performance.
2. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater, Approved Inspector, as defined by ANSI / RESNET / IECC Standard 301, or an equivalent designation as determined by a Home Certification Organization (HCO) or Multifamily Review Organization (MRO); and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/mftraining.
3. The dwelling-unit mechanical ventilation system shall have at least one supply or exhaust fan with associated ducts and controls. Local exhaust fans are allowed to be part of a dwelling-unit mechanical ventilation system. Designers may provide supplemental documentation as needed to document the system design.
4. In "Warm-Humid" climates as defined by 2009 IECC Figure 301.1 (i.e., CZ 1 and portions of CZ 2 and 3A below the white line), it is recommended, but not required, that equipment be specified with sufficient latent capacity to maintain indoor relative humidity at $\leq 60\%$.
5. Airflow design rates and run-times shall be determined using ASHRAE 62.2-2010 or later. Designers are permitted, but not required, to use published addenda and/or the 2013 version of the standard to assess compliance.
6. Airflow design rates shall be determined using ASHRAE 62.1-2010 or later. Designers are permitted, but not required, to use published addenda and/or the 2013 version of the standard to assess compliance.
7. If the tables provided cannot accommodate all the unit plans, spaces, or systems in the project, use the tables in Appendix A to supplement the Design Report.
8. In addition, consult manufacturer requirements to ensure return air temperature requirements are met.
9. Dwelling-unit mechanical ventilation fans shall be rated for sound at no less than the airflow rate in Item 2.7. Fans exempted from this requirement include HVAC air handler fans, remote-mounted fans, and intermittent fans rated ≥ 400 CFM. To be considered for this exemption, a remote-mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways and there shall be ≥ 4 ft. ductwork between the fan and intake grill. Per ASHRAE 62.2-2010, habitable spaces are intended for continual human occupancy; such space generally includes areas used for living, sleeping, dining, and cooking but does not generally include bathrooms, toilets, hallways, storage areas, closets, or utility rooms.
10. Bathroom fans with a rated flow rate ≥ 500 CFM are exempted from the requirement to be ENERGY STAR certified.
11. Without proper maintenance, ventilation air inlet screens often become filled with debris. Therefore, EPA recommends, but does not require, that these ventilation air inlets be located so as to facilitate access and regular service by the building maintenance staff.
12. Continuous bathroom local mechanical exhaust fans shall be rated for sound at no less than the design airflow rate. Intermittent bathroom and both intermittent and continuous kitchen local mechanical exhaust fans are recommended, but not required, to be rated for sound at no less than the design airflow rate. Per ASHRAE 62.2-2010, an exhaust system is one or more fans that remove air from the building, causing outdoor air to enter by ventilation inlets or normal leakage paths through the building envelope (e.g., bath exhaust fans, range hoods, clothes dryers). Per ASHRAE 62.2-2010, a bathroom is any room containing a bathtub, shower, spa, or similar source of moisture.
13. An intermittent mechanical exhaust system, where provided, shall be designed to operate as needed by the occupant. Control devices shall not impede occupant control in intermittent systems.
14. Kitchen volume shall be determined by drawing the smallest possible rectangle on the floor plan that encompasses all cabinets, pantries, islands, peninsulas, ranges / ovens, and the kitchen exhaust fan, and multiplying by the average ceiling height for this area. In addition, the continuous kitchen exhaust rate shall be ≥ 25 CFM, per 2009 IRC Table M1507.3, regardless of the rate calculated using the kitchen volume. Cabinet volume shall be included in the kitchen volume.
15. While not required, the prescriptive duct sizing requirements in Table 5.3 of ASHRAE 62.2-2010 are recommended to be used for kitchen exhaust fans based upon the rated airflow of the fan at 0.25 IWC.
16. As an alternative, dwelling units are permitted to use a continuous kitchen exhaust rate of 25 CFM per 2009 IRC Table M1507.3, if they are either a) PHIUS+ or PHI certified, or b) provide both dwelling unit ventilation and local mechanical kitchen exhaust using a balanced system, and have a Rater-verified whole-building infiltration rate ≤ 1.0 ACH50 or ≤ 0.05 CFM50 per ft² of Enclosure Area. 'Enclosure Area' is defined as the area of the surfaces that bound the volume being pressurized / depressurized during the test.
17. All intermittent kitchen exhaust fans must be capable of exhausting at least 100 CFM. In addition, if the fan is not part of a vented range hood or appliance-range hood combination (i.e., if the fan is not integrated with the range), then it must also be capable of exhausting ≥ 5 ACH, based on the kitchen volume.
18. For continuous system operation, the lower rate may be used. Otherwise, use the higher rate. Commercial kitchens shall be designed to provide a minimum continuous rate of 0.70 cfm/ft².
19. As an alternative, for a toilet room intended to be occupied by one person at a time, a minimum continuous rate of 25 cfm is permitted.



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20. This section / item applies to split air conditioners, unitary air conditioners, air-source heat pumps, and water-source (i.e., geothermal) heat pumps up to 65 kBtuh with forced-air distribution systems and to furnaces up to 225 kBtuh with forced-air distribution system serving individual dwelling units. Forced-air distribution systems are those that supply air through ductwork exceeding 0 ft. in length. This section / item is recommended, but not required for non-ducted systems, such as non-ducted mini-splits, multi-splits, PTHP's, or PTAC's.
21. Select "2013 / 2017 ASHRAE Fundamentals" if using Chapter 17 of the 2013 or 2017 ASHRAE Handbook of Fundamentals. Select "Other per AHJ" if the Authority Having Jurisdiction where the unit will be certified mandates the use of a load calculation methodology other than Unabridged ACCA Manual J v8 or 2013 or 2017 ASHRAE Handbook of Fundamentals.
22. Check the box for "unit-specific design" if the design was created for the specific plan configuration (i.e., elevation, option, orientation, and county) of the unit to be certified. Check the box for "group design" if designs were created for unit plans that are repeated throughout the project / building with potentially different configurations (i.e., different elevations and/or orientations). Check the box for "worst-case design" if loads for the unit with the largest heat gain in the project / building are less than 18 kBtuh and are being used to represent all other units. Only one box may be checked. Regardless of the box checked, the system design as documented on this HVAC Design Report must fall within the following tolerances for the unit to be certified:
- Item 3.4: The outdoor design temperature used in loads are within the limits defined at www.energystar.gov/hvacdesigntemps.
 - Item 3.6: The number of occupants used in loads is within ± 2 of the dwelling unit to be certified.
 - Item 3.7: Total occupant gains used in loads shall not exceed 645 Btuh per occupant.
 - Item 3.8: The conditioned floor area used in loads is between 100 ft² smaller and 300 ft² larger than the dwelling unit to be certified.
 - Item 3.9: The window area used in loads is between 15 ft² smaller and 60 ft² larger than the dwelling unit to be certified, or for dwelling units with > 500 ft² of window area, between 3% smaller and 12% larger.
 - Item 3.10: The predominant window SHGC is within 0.1 of the predominant value in the dwelling unit to be certified.
 - Item 3.12: The mechanical ventilation rate used in loads is the same as the value in Section 2a for the given unit plan.
 - Item 3.13: The sum of the internal gains associated with lighting and appliances used in loads shall not exceed 3,600 Btuh.
 - Items 3.15 & 3.17: The sensible & total heat gain are documented for the orientation of the dwelling unit to be certified.
 - Item 4.18: The cooling sizing % is within the cooling sizing limit selected.

Provide the National HVAC Design Report to the party you are providing these design services to (i.e., a builder / developer, Functional Testing Agent (FT Agent), and/or MEP / credentialed HVAC contractor) and to the Rater. The report is only required to be provided once per project / building. As long as a report has been provided that falls within these tolerances for the units to be certified, no additional work is required. However, if no report falls within these tolerances or if any aspect of the system design changes, then an additional report will need to be generated prior to certification.

Visit www.energystar.gov/hvacdesigntools for a tool to assist with group designs and for more information.

23. For each unique unit floorplan, document the loads for the configuration (e.g., level, orientation) that the dwelling unit might be built in. For example, if a unit plan will only be built in a specific level and orientation (e.g., top-floor, facing South), then the designer only needs to document the loads for this one configuration. Orientation represents the direction that the front door of the dwelling unit is facing. In Section 4, to calculate Cooling sizing % for each configuration of each unique floorplan, the same system may need to be duplicated in multiple columns.
24. Visit www.energystar.gov/hvacdesigntemps for the maximum cooling season design temperature and minimum heating season design temperature permitted for ENERGY STAR. For "County & State, or US Territory, selected", select the County and State or US Territory (i.e., Guam, Northern Mariana Islands, Puerto Rico, or US Virgin Islands), where the unit is to be certified. The same design report is permitted to be used in other counties, as long as the design temperature limits in those other counties meet or exceed the cooling and heating season temperature limits for the county selected. For example, if Fauquier County, VA, is used for the load calculations, with a 1% cooling temperature limit of 93°F, then the same report could be used in Fairfax County (which has a higher limit of 94°F) but not in Arlington County (which has a lower limit of 92°F). If a jurisdiction-specified design temperature is used that exceeds the limit in the ENERGY STAR Single-Family New Homes Design Temperature Limit Reference Guide, designers must submit a Design Temperature Exception Request. Visit www.energystar.gov/hvacdesigntemps for a copy of this form.
25. To determine the number of occupants among all HVAC systems in the dwelling unit, calculate the number of bedrooms, as defined below, and add one. This number of occupants must be within ± 2 of the dwelling unit to be certified.
- A bedroom is defined by ANSI / RESNET / ICC Standard 301-2014 as a room or space 70 ft² or greater size, with egress window and closet, used or intended to be used for sleeping. A "den", "library", or "home office" with a closet, egress window, and 70 ft² or greater size or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.
- An egress window, as defined in 2009 IRC section R310, shall refer to any operable window that provides for a means of escape and access for rescue in the event of an emergency. The egress window definition has been summarized for convenience. The egress window shall:
- have a sill height of not more than 44 inches above the floor; AND
 - have a minimum net clear opening of 5.7 ft²; AND
 - have a minimum net clear opening height of 24 in.; AND
 - have a minimum net clear opening width of 20 in.; AND
 - be operational from the inside of the room without the use of keys, tools or special knowledge.
26. The difference between the Conditioned Floor Area (CFA) used in the design and the actual dwelling unit to be certified must fall within the tolerance specified in Footnote 22, as verified by a Rater. Be advised, the Rater will calculate CFA using the definition in ANSI / RESNET / ICC Standard 301-2019, which defines this value, in part, as the floor area of the Conditioned Space Volume within a building or Dwelling Unit, not including the floor area of attics, crawlspaces, and basements below air sealed and insulated floors. See www.codes.iccsafe.org/content/chapter/16185/ for the complete definition.



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27. The difference between the window area used in the design and the actual dwelling unit to be certified must fall within the tolerance specified in Footnote 22, as verified by a Rater. Be advised, the Rater will calculate window area using the on-site inspection protocol provided in Normative Appendix B of ANSI / RESNET / ICC Standard 301-2019, which instructs the Rater to measure the width and height of the rough opening for the window and round to the nearest inch, and then to use these measurements to calculate window area, rounding to the nearest tenth of a square foot. See www.codes.iccsafe.org/content/chapter/16191/ for the complete protocol.
28. "Predominant" is defined as the SHGC value used in the greatest amount of window area in the dwelling unit.
29. Infiltration rate shall use "Tight" values for the cooling season infiltration rate and "Tight" values for the heating season infiltration rate, as defined by Table 5A or 5B of ACCA Manual J, Eighth Edition, Version Two. Alternatively, infiltration rate shall not exceed 0.24 air changes per hour.
30. Equipment shall be selected using the maximum total heat gain and the total heat loss in Section 3 per ACCA Manual S, Second Edition, except that cooling ranges above ACCA Manual S limits are temporarily allowed, per Item 4.19, and heating ranges above ACCA Manual S limits are allowed where heating and hot water are provided by the same equipment or where standby equipment is needed for redundancy, but only operate when the primary equipment is not operating. For equipment outside the scope of ACCA Manual S, "Other" may be indicated and the equipment sizing approach listed in the space provided.
31. If an AHRI Reference # is not available, OEM-provided documentation shall be attached with the rated efficiency of the specific combination of indoor and outdoor components of the air conditioner or heat pump, along with confirmation that the two components are designed to be used together.
32. Capacity will be listed as the capacity at design conditions, from OEM expanded performance data, and shall include the capacity of all systems providing space cooling to the dwelling unit.
33. Per ACCA Manual S, Second Edition, if the load sensible heat ratio is $\geq 95\%$ and the HDD / CDD ratio is ≥ 2.0 , then the Climate is Condition B, otherwise it is Condition A.
34. As an alternative for low-load dwelling units, a system match-up including a single-speed compressor with a total capacity ≤ 20 kBtuh is permitted to be used in spaces with a total cooling load ≤ 15 kBtuh. A system match-up including a two-speed or variable-speed compressor with a total capacity ≤ 25 kBtuh is permitted to be used in spaces with a total cooling load ≤ 18 kBtuh.
35. Per the 2009 International Mechanical Code, a direct-vent furnace or boiler is one that is constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outside atmosphere; a mechanical draft system is a venting system designed to remove flue or vent gases by mechanical means consisting of an induced draft portion under non-positive static pressure or a forced draft portion under positive static pressure; and a natural draft system is a venting system designed to remove flue or vent gases under non-positive static vent pressure entirely by natural draft. Naturally drafted equipment is only allowed if located in a space outside the pressure boundary, where the envelope assemblies separating it from conditioned space are insulated and air-sealed.
36. Designers may provide supplemental documentation with room-by-room and total design airflows in lieu of completing Item 5.5. Sample supplemental documentation can be found at www.energystar.gov/hvacdesigntools.
37. Orientation-specific room-by-room design airflows are recommended, but not required, to distribute airflow proportional to load, thereby improving comfort and efficiency. While air-balancing of supply registers and return grilles is not required to be completed as part of HVAC Functional Testing, it is recommended that ducted HVAC systems be designed such that they can be balanced in the field (i.e. provide proper access to any and all balancing dampers, provide ducting and grille layouts such that accurate air measurements can be taken).
38. Design HVAC fan airflow is the design airflow for the blower in CFM, as determined using the manufacturer's expanded performance data. The Functional Testing Agent is required to measure the HVAC fan airflow using the mode with the higher airflow, within $\pm 15\%$ of design.
39. Design HVAC fan speed setting is the fan speed setting on the control board (e.g., low, medium, high) that corresponds with the Design HVAC fan airflow.
40. Design total external static pressure is the pressure corresponding to the Design HVAC fan airflow, inclusive of external components (e.g., evaporator coil, whole-house humidifier, or \geq MERV 6 filter).
41. Kinks are to be avoided and are caused when ducts are bent across sharp corners such as framing members. Sharp bends are to be avoided and occur when the radius of the turn in the duct is less than one duct diameter. Compression is to be avoided and occurs when flexible ducts in unconditioned space are installed in cavities smaller than the outer duct diameter and ducts in conditioned space are installed in cavities smaller than inner duct diameter. Ducts shall not include coils or loops except to the extent needed for acoustical control.
42. Item 6.3 does not apply to ducts that are a part of local mechanical exhaust or exhaust-only dwelling-unit ventilation systems. EPA recommends, but does not require, that all metal ductwork not encompassed by Section 6 (e.g., exhaust ducts, duct boots, ducts in conditioned space) also be insulated and that insulation be sealed to duct boots to prevent condensation.
43. Item 6.5 generally applies to the ducts of space heating, space cooling, and dwelling unit mechanical ventilation systems. However, visual inspection is permitted in lieu of testing for the following system types: 1) a dwelling unit mechanical ventilation system not connected to the space heating or space cooling system, regardless of the number of dwelling units it serves; 2) a space heating or space cooling system for which the ducts and air handler are in conditioned space and the total supply duct length of the system, including all supply trunks and branches, is ≤ 10 ft; and 3) a space heating or space cooling system that serves more than one dwelling unit. In such cases, a Rater shall visually verify that all seams and connections are sealed with mastic or metal tape and all duct boots are sealed to floor, wall, or ceiling using caulk, foam, or mastic tape.
44. Duct leakage shall be determined and documented by a Rater in accordance with ANSI / RESNET / ICC Std. 380. Leakage limits shall be assessed on a per-system, rather than per-dwelling unit, basis. For a duct system with one or two returns, the total Rater-measured duct leakage is permitted to be the greater of ≤ 4 CFM25 per 100 ft² of CFA or ≤ 40 CFM25 at 'rough-in' or the greater of ≤ 8 CFM25 per 100 ft² of CFA or ≤ 8 CFM25 at 'final'. For a duct system with three or more returns, the total Rater-measured duct leakage is permitted to be the greater of ≤ 6 CFM25 per 100 ft² of CFA or ≤ 60 CFM25 at 'rough-in' or the greater of ≤ 12 CFM25 per 100 ft² of CFA or ≤ 120 CFM25 at 'final'. For a duct system without any ducted returns, the total Rater-measured duct leakage is permitted to be the greater of ≤ 3 CFM25 per 100 ft² of CFA or ≤ 30 CFM25 at 'rough-in' or the greater of ≤ 6 CFM25 per 100 ft² of CFA or ≤ 60 CFM25 at 'final' and, the Rater-measured pressure difference between the space containing the air handler and the conditioned space, with the air handler running at high speed, is ≤ 5 Pa. For systems > 1 ton, increase by 1 Pa per half ton.



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45. For the purpose of computing leakage allowance, exhaust fan flow shall be the lesser of the rated fan flow and at rough-in, 133% of the sum of the design exhaust airflow of the dwelling units that are exhausted by that central fan or at final, 143% of the sum of the design exhaust airflow of the dwelling units that are exhausted by that central fan. Measured fan flow (either at the fan itself or the total airflow measured from all exhaust grilles served by the fan) may be used in lieu of the rated fan flow to determine the leakage allowance. This test is not required of central exhaust systems serving clothes dryers.



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Appendix A – Supplementary tables for Section 2 and 3

2a. Dwelling Unit & Common Space Mechanical Ventilation Design ^{3, 4}						
List unique unit plan for which 62.2 ventilation rates were calculated in the spaces to the right:						
2.4 # of bedrooms:						
2.5 Square footage:						
2.6 Ventilation airflow rate required by ASHRAE 62.2:						
2.7 Ventilation airflow rate designed:						
2.7.1 If applicable, run-time per cycle (minutes):						
2.7.2 If applicable, cycle time (minutes):						

List common space for which 62.1 ventilation rates were calculated in the spaces to the right:						
2.8 Ventilation airflow rate required by ASHRAE 62.1:						
2.9 Ventilation airflow rate designed:						

System Type & Controls:						
List Ventilation System ID in the spaces to the right:						
2.10 Specified system type: (e.g., supply, exhaust, balanced, ERV, HRV)						
2.11 Specified system type: (e.g., in-unit, central)						
2.12 Manufacturer:						
2.13 Model Number:						
2.14 Area / space(s) that system serves: (e.g., Unit A kitchens, corridor, community room)						
2.15 Specified control location: (e.g., Master bath, utility):						

3. Heating & Cooling Loads							
Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces) ¹⁹ <input type="checkbox"/> N/A							
List the unit plan for which Loads were calculated:							
3.5 Location of Unit: top, mid, bottom, corner, interior							
3.6 Number of occupants used in loads: ^{22, 25}							
3.7 Total occupant gains (Btuh): ²²							
3.8 Conditioned floor area used in loads: ^{22, 26}							
3.9 Window area used in loads: ^{22, 27}							
3.10 Predominant window SHGC used in loads: ^{22, 28}							
3.11 Infiltration (ACH / ACH50) used in loads: ²⁹							
3.12 Mechanical ventilation (CFM) used in loads:							
3.13 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): ²²							
3.14 Orientation (N, NE, E, SE, S, SW, W, NW): ²³							
3.15 Sensible Heat Gain At Design Conditions (kBtuh): ²²							
3.16 Latent Heat Gain At Design Conditions (kBtuh):							
3.17 Total Heat Gain at Design Conditions (kBtuh): ²²							
3.18 Total Heat Loss at Design Conditions (kBtuh):							



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Appendix A – Supplementary tables for Section 3

3.19 Common Space Heating & Cooling Loads		
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)

3.20 Building Heating & Cooling Loads (only required when shared systems such as central boilers or chillers are specified)		
System Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
System Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
System Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)
System Name: _____	Design Conditions: Total Heat Gain: _____ (kBtuh)	Total Heat Loss: _____ (kBtuh)



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Appendix A – Supplementary tables for Section 4

4. Heating & Cooling Equipment Selection							
Cooling Equipment (Complete all applicable items, noting "N/A" as needed; where the same Equipment ID is used in multiple spaces (columns), identical data is not required to be repeated and can be left blank; where cooling is not provided, check "N/A".) <input type="checkbox"/> N/A							
List Cooling Equipment ID in the spaces to the right; duplicating as needed for each unique space served:							
4.4 Equipment type: (PTAC / AC, Chiller / CT, PTHP / WLHP / GSHP / ASHP / VRF)							
4.5 Area / Space(s) that system serves:							
4.6 Chiller / condenser / outdoor unit manufacturer:							
4.7 Chiller / condenser / outdoor unit model #:							
4.8 Evaporator / indoor unit manufacturer:							
4.9 Evaporator / indoor unit model #:							
4.10 AHRI reference #: ³¹							
4.11 AHRI listed efficiency:							
4.12 Evaporator fan type: PSC, ECM / ICM Other:							
4.13 Compressor speed: Single, Two, Variable							
4.14 Turn down ratio (for variable speed equipment):							
4.15 Latent capacity at design conditions (kBtuh): ³²							
4.16 Sensible capacity at design conditions (kBtuh): ³²							
4.17 Total capacity at design conditions (kBtuh): ³²							
4.18 Cooling sizing % = Total capacity (Item 4.17) divided by Total Heat Gain (Item 3.17) of space(s) in Item 4.5: ²²							
4.19 Meets cooling sizing limit: (A, B, C, D or N/A) ²⁰							
4.20 If "B", list Load sensible heat ratio = Max. sensible heat gain (Item 3.15) / Max. total heat gain (Item 3.17): ³⁰							
4.21 If "B", calculate HDD / CDD ratio: ³³							
Equipment Type & Climate Condition	Compressor Type (Per Item 4.13)						
	Single-Speed	Two-Speed		Variable-Speed			
A: For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate ³³	Recommended: 90 – 115% Allowed: 90 – 130%	Recommended: 90 – 120% Allowed: 90 – 140%		Recommended: 90 – 130% Allowed: 90 – 160%			
B: For Cooling Mode of Heat Pump in Condition B Climate ³³	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh		90% - 100%, plus 15 kBtuh			
C: For low-load spaces (≤15 kBtuh) ³⁴	≤ 20 kBtuh						
D: For low-load spaces (≤18 kBtuh) ³⁴			≤ 25 kBtuh		≤ 25 kBtuh		
Heating Equipment (Complete all applicable items, noting "N/A" as needed; where the same Equipment ID is used in multiple spaces (columns), identical data is not required to be repeated and can be left blank; where heating is not provided, check "N/A".) <input type="checkbox"/> N/A							
List Heating Equipment ID in the spaces to the right; duplicating as needed for each unique space served:							
4.22 Electric equipment type: PTHP, WLHP, GSHP, ASHP, VRF, Boiler, Furnace, Electric Resistance							
4.23 Gas Equipment type: HW PTAC / fan coil, Gas-Fired PTAC, Boiler, Furnace							
4.24 Area / Space(s) that system serves:							
4.25 Manufacturer:							
4.26 Model Number:							
4.27 Listed efficiency:							
4.28 Equipment output capacity (kBtuh):							
4.29 Air-source heat pump output capacity (kBtuh) (17°F):							
4.30 Type of Venting: Natural Draft, Mechanically Drafted, Direct Vent ³⁵							



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4.31 Furnace heating sizing % = Total capacity (Item 4.28) divided by Total Heat Loss of space(s) in Item 4.24:							
4.32 Meets furnace sizing limit: (A, B, C, or N/A) ²⁰							
A: For low-load spaces (≤ 10 kBtuh), furnace output capacity is ≤ 40 kBtuh							
B: When Used for Heating Only				C: When Paired With Cooling			
100 – 400%				Recommended: 100 – 140% Allowed: 100 – 400%			

Appendix A – Supplementary tables for Section 5

5. Dwelling-Unit Duct Design

5.2 Room-by-room design airflows documented below (which should sum to the mode with the higher Design HVAC fan airflow). ^{7, 36, 37}

Name of the unit plan:		Name of the unit plan:	
Design HVAC fan airflow: ³⁸ Cooling mode _____ CFM Heating mode _____ CFM		Design HVAC fan airflow: ³⁸ Cooling mode _____ CFM Heating mode _____ CFM	
Design HVAC fan speed setting (e.g., low, medium, high): ³⁹ Cooling mode _____ Heating mode _____		Design HVAC fan speed setting (e.g., low, medium, high): ³⁹ Cooling mode _____ Heating mode _____	
Design total external static pressure (corresponding to the mode with the higher airflow above): ⁴⁰ _____ IWC		Design total external static pressure (corresponding to the mode with the higher airflow above): ⁴⁰ _____ IWC	
Room Name	Design Airflow (CFM)	Room Name	Design Airflow (CFM)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
Total for all rooms		Total for all rooms	

Name of the unit plan:		Name of the unit plan:	
Design HVAC fan airflow: ³⁸ Cooling mode _____ CFM Heating mode _____ CFM		Design HVAC fan airflow: ³⁸ Cooling mode _____ CFM Heating mode _____ CFM	
Design HVAC fan speed setting (e.g., low, medium, high): ³⁹ Cooling mode _____ Heating mode _____		Design HVAC fan speed setting (e.g., low, medium, high): ³⁹ Cooling mode _____ Heating mode _____	
Design total external static pressure (corresponding to the mode with the higher airflow above): ⁴⁰ _____ IWC		Design total external static pressure (corresponding to the mode with the higher airflow above): ⁴⁰ _____ IWC	
Room Name	Design Airflow (CFM)	Room Name	Design Airflow (CFM)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
Total for all rooms		Total for all rooms	



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Project Name: _____		Number of Units: _____		Permit Date: _____	
Project Address: _____		City: _____		State: _____	
Thermal Enclosure System		Must Correct	Builder Verified ³	Rater Verified ⁴	N/A ⁵
1. High-Performance Fenestration & Insulation					
1.1 Fenestration meets or exceeds specification in Items 2.1 & 2.2 of the Natl Rater Design Review Checklist.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
1.2 Insulation meets or exceeds specification in Items 3.1 & 3.2 of the Natl Rater Design Review Checklist.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
1.3 All insulation achieves Grade I install. per ANSI / RESNET / ICC Std. 301. Alternatives in Footnote 6. ^{6,7}		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
1.4 Prescriptive Path: Window-to-wall ratio ≤ 30%. ⁸		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 Heated plenums in unconditioned space or ambient conditions must meet the following requirements: ⁹					
1.5.1 Sides of heated plenum are an air barrier and insulated to ≥ R-3ci in CZ 1-4; ≥ R-5ci in CZ 5-6; ≥ R-7.5ci in CZ 7; ≥ R-9.5ci in CZ 8, AND ;		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5.2 Insulation at top of heated plenum meets or exceeds the R-value for mass floors from the "All Other" column of Table 502.2(1) of 2009 IECC, AND ;		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5.3 Bottom of heated plenum must have at least R-13 insulation. ¹⁰		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6 Garages with space heating must meet the following requirements: ⁹					
1.6.1 Insulation on above grade walls and walls on the first story below grade ≥ R-5ci in CZ 5-6; ≥ R-7.5ci in CZ 7; ≥ R-9.5ci in CZ 8, AND ;		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6.2 Ceiling insulation meets or exceeds the R-value for mass floors from the "All Other" column of Table 502.2(1) of 2009 IECC.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Fully-Aligned Air Barriers ¹¹ At each insulated location below, a complete air barrier is provided that is fully aligned as follows:					
<u>Ceilings</u> : At interior or exterior horizontal surface of ceiling insulation in Climate Zones 1-3; at interior horizontal surface of ceiling insulation in Climate Zones 4-8. Also, at exterior vertical surface of ceiling insulation in all climate zones (e.g., using a wind baffle that extends to the full height of the insulation in every bay or a tabbed baffle in each bay with a soffit vent that prevents wind washing in adjacent bays). ¹²					
2.1 Dropped ceilings / soffits below unconditioned attics, chase / dead space, and all other ceilings.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>Walls</u> : At exterior vertical surface of wall insulation in all climate zones; also at interior vertical surface of wall insulation in Climate Zones 4-8. ¹³					
2.2 Walls behind showers, tubs, staircases, and fireplaces.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3 Architectural bump-outs, dead space, and all other exterior walls.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
<u>Floors</u> : At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surface including supports to ensure alignment. Alternatives in Footnotes 15 & 16. ^{14, 15, 16}					
2.4 Floors above garages, floors above unconditioned spaces, and cantilevered floors.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.5 All other floors adjoining unconditioned space (e.g., rim / band joists at exterior wall or at porch roof).		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Reduced Thermal Bridging					
3.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade I insulation extends to the inside face of the exterior wall below and is ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8. ¹⁷		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 For insulated ceilings with attic space above, attic access panels and drop-down stairs insulated ≥ R-10 or equipped with durable ≥ R-10 cover. ¹⁸		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4 For slabs on grade in CZ 4-8, 100% of slab edge insulated to ≥ R-5 at the depth specified by Table 502.2(1) of the 2009 IECC and aligned with the thermal boundary of the walls. ^{19, 20}		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.5 For elevated concrete slabs in CZ 4-8 (i.e., podiums and projected balconies, but not intermediate slab floor edges) 100% of the slab edge insulated to ≥ R-5. For podiums, this insulation must extend for a minimum of 8ft below the bottom of the slab edge. For columns, the insulation must surround the column, at a depth of 4ft. Alternatives in Footnote 21. ²¹		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.6 For elevated concrete slabs in CZ 4-8 (i.e., podiums, but not intermediate floor slabs), floor insulation meets the U-factor specified in Table 502.1.2 of the 2009 IECC for Group R when dwelling units are above the slab, and for 'All Other' when common space is above the slab. ²²		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7 At above-grade walls and rim / band joists separating conditioned space from the exterior, one of the following options used: ^{23, 26}					
3.7.1 Continuous rigid insulation, insulated siding, or combination of the two is: ≥ R-3 in CZ 1-4; ≥ R-5 in CZ 5-8 ^{24, 25, 26, 27} , OR ;		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7.2 Structural Insulated Panels OR ; Insulated Concrete Forms OR ; Double-wall framing OR ; ^{24, 26, 28}		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7.3 Option only for wood-framed walls either in CZ 1-3 OR ≤ 3 stories: 'advanced framing' details including all of the Items below: ^{26, 29}					
3.7.3a Corners insulated ≥ R-6 to edge ³⁰ , AND ;		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7.3b Headers above windows & doors insulated ≥ R-3 for 2x4 framing or equivalent cavity width, and ≥ R-5 for all other assemblies (e.g., with 2x6 framing) ³¹ , AND ;		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7.3c Interior / exterior wall intersections insulated to same R-value as rest of exterior wall. ³²		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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4. Air Sealing (Unless otherwise noted below, "sealed" indicates the use of caulk, foam, or equivalent material.)		Must Correct	Builder Verified ³	Rater Verified ⁴	N/A ⁵
The following items must be verified in dwelling units and common spaces to reduce air leakage to exterior, adjacent buildings, or unconditioned spaces.					
4.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
4.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to \geq R-10 in CZ 4-8.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 Continuous top plate or blocking is at top of walls adjoining unconditioned space including at balloon-framed parapets, and sealed.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5 Rough opening around windows & exterior doors sealed. ³³		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
4.6 Assemblies that separate attached garages from occupiable space sealed and, also, an air barrier installed, sealed, and aligned with these assemblies. ³⁴		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.7 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air-tight with doorsweep and weatherstripping or equivalent gasket.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.8 Attic access panels, roof hatches and drop-down stairs are gasketed (i.e., not caulked) or equipped with durable covers that are gasketed. ¹⁸		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The following items must be additionally verified in dwelling units, to reduce air leakage between conditioned spaces.					
4.9 Doors serving as a unit entrance from a corridor/stairwell made substantially air-tight with doorsweep and weatherstripping or equivalent gasket.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.10 Rater-measured compartmentalization is no greater than 0.30 CFM50 per square feet of dwelling unit enclosure area, following procedures in ANSI / RESNET / ICC Std. 380. ³⁵		<input type="checkbox"/>	-	<input type="checkbox"/>	
4.10.1 For dwelling units with forced air distribution systems without ducted returns and located in a closet adjacent to unconditioned space, the Rater-measured pressure difference between the space containing the air handler and the conditioned space during the compartmentalization test is no greater than 5 Pa. ³⁶		<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
HVAC System ³⁷			Must Correct	Rater Verified ⁴	N/A ⁵
5. Heating & Cooling Eqpt. Complete Track A - HVAC Grading by Rater OR Track B – HVAC Testing by FT Agent ³⁸					
Track A ³⁹	5a.1 Blower fan volumetric airflow is Grade I or II per ANSI / RESNET / ACCA Std. 310		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5a.2 Blower fan watt draw is Grade I or II per ANSI / RESNET / ACCA Std. 310		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5a.3 Refrigerant charge is Grade I per ANSI / RESNET / ACCA Std. 310. See Footnote 40 for exemptions. ⁴⁰		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Track B	5b.1 HVAC manufacturer & model number on installed equipment matches either of the following (check box): ⁴¹ <input type="checkbox"/> National HVAC Design Report (4.6-4.9 & 4.25-4.26) <input type="checkbox"/> Written approval received from designer		<input type="checkbox"/>	<input type="checkbox"/>	-
	5b.2 External static pressure measured by Rater at contractor-provided test locations and documented below: ⁴² Return-Side External Static Pressure: _____ IWC Supply-Side External Static Pressure: _____ IWC		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.4 Prescriptive Path: Heating and cooling equipment serving dwelling units and common spaces meet the efficiency levels specified in the Exhibit X. Electric resistance space heating is not installed in dwelling units.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.5 ERI Path: Heating and cooling equipment serving common spaces, but <u>not</u> serving dwelling units, meet the efficiency levels specified in the Exhibit X. See Exhibit X for restrictions on electric resistance space heating.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.6 National HVAC Functional Testing Checklist(s) collected prior to certification, with all HVAC systems in the building / project fully documented. Exception: Where credentialed HVAC Contractor(s) are completing the National HVAC Functional Testing Checklist, the checklist is not required to be collected for the systems they verify. ⁴³			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.7 Rater has verified and documented that Functional Testing Agent(s) ("FT Agent(s)") completing the National HVAC Functional Testing Checklist(s) hold one of the required credentials and completed orientation, if applicable. ⁴³ Credential(s): _____ FT Agent Name(s): _____			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equipment Controls			Must Correct	LP Verified ⁴⁴	Rater Verified ⁴
5.8 All heating and cooling systems serving a dwelling unit have thermostatic controls within the dwelling unit which are not located on exterior walls.			<input type="checkbox"/>	-	<input type="checkbox"/>
5.8.1 Prescriptive Path: Dwelling unit thermostats are programmable.			<input type="checkbox"/>	-	<input type="checkbox"/>
5.9 Stair and elevator shaft vents equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems. Dampers are verified to be closed at the time of inspection.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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5.10 Freeze protection systems, such as heat tracing of piping and heat exchangers, including self-regulating heat tracing, and garage / plenum heaters include automatic controls that are verified to shut off the systems when pipe wall or garage / plenum temperatures are above 40°F.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.10.1 Where heat tracing is installed for freeze-protection, controls must be based on pipe wall temperature and a minimum of R-3 pipe insulation is also required.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.11 Snow- and ice-melting systems include automatic controls that are verified to shut off the systems when the pavement temperature is above 50°F and no precipitation is falling, and an automatic or manual control is installed that is verified to shut off system when the outdoor temperature is above 40°F, so that the potential for snow or ice accumulation is negligible.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hydronic Distribution				
5.12 For hydronic distribution systems, all terminal heating and cooling distribution equipment are separated from the riser or distribution loop by a control valve or terminal distribution pump, so that heated or cooled fluid is not delivered to the dwelling unit distribution equipment when there is no call from the thermostat.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.13 Terminal units in hydronic distribution systems are equipped with pressure independent balancing valves or pressure independent control valves.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.14 Piping of a heating or cooling system is insulated in accordance with Item 4.41 on the National HVAC Design Report, including where passing through planks or any other penetrations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.15 For circulating pumps serving hydronic heating or cooling systems with three-phase motors, 1 horsepower or larger, motors meet or exceed efficiency standards for NEMA Premium™ motors. If 5 horsepower or larger, also installed with variable frequency drives.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Duct Quality Installation - Applies to Heating, Cooling, Ventilation, Exhaust, & Pressure Balancing Ducts, Unless Noted in Footnote.	Must Correct	Rater Verified ⁴	N/A ⁵	
6.1 Ductwork installed without kinks, sharp bends, compressions, or excessive coiled flexible ductwork. ⁴⁵	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.2 Bedrooms with a design supply airflow \geq 150 CFM (per Item 5.2 on the National HVAC Design Report) pressure-balanced (e.g., using transfer grilles, jump ducts, dedicated return ducts, undercut doors) to achieve a Rater-measured pressure differential \geq -5 Pa and \leq +5 Pa with respect to the main body of the dwelling unit when all air handlers are operating. See Footnote 46 for test configuration. ⁴⁶	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.3 All supply and return ducts in unconditioned space, including connections to trunk ducts, are insulated to \geq R-6. ⁴⁷	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.3.1 Prescriptive Path: Dwelling unit ductwork meets the location and insulation requirements specified in the ENERGY STAR Multifamily Reference Design.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.4 Rater-measured total duct leakage in dwelling units meets one of the following two options: ^{48, 49}				
6.4.1 <u>Rough-in</u> : Tested per allowances below, with air handler & all ducts, building cavities used as ducts, & duct boots installed. In addition, <u>all</u> duct boots sealed to finished surface, Rater-verified at final. ⁵⁰ <u>No ducted returns</u> ³⁶ : The greater of \leq 3 CFM25 per 100 sq. ft. of CFA or \leq 30 CFM. Additionally, the Rater-measured pressure difference between the space containing the air handler and the conditioned space, with the air handler running at high speed, is \leq 5 Pa. For systems > 1 ton, increase by 1 Pa per half ton. <u>One or two ducted returns</u> ³⁶ : The greater of \leq 4 CFM25 per 100 sq. ft. of CFA or \leq 40 CFM. <u>Three or more ducted returns</u> ³⁶ : The greater of \leq 6 CFM25 per 100 sq. ft. of CFA or \leq 60 CFM.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.4.2 <u>Final</u> : Tested per allowances below, with the air handler & all ducts, building cavities used as ducts, duct boots, & register grilles atop the finished surface (e.g., drywall, floor) installed. ⁵¹ <u>No ducted returns</u> ³⁶ : The greater of \leq 6 CFM25 per 100 sq. ft. of CFA or \leq 60 CFM. Additionally, the Rater-measured pressure difference between the space containing the air handler and the conditioned space, with the air handler running at high speed, is \leq 5 Pa. For systems > 1 ton, increase by 1 Pa per half ton. <u>One or two ducted returns</u> ³⁶ : The greater of \leq 8 CFM25 per 100 sq. ft. of CFA or \leq 80 CFM. <u>Three or more ducted returns</u> ³⁶ : The greater of \leq 12 CFM25 per 100 sq. ft. of CFA or \leq 120 CFM.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.5 Townhouses only: Rater-measured duct leakage to the outside the greater of \leq 4 CFM25 per 100 sq. ft. of CFA or \leq 40 CFM25. ^{48, 52}	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.6 Common Space: Supply, return, and exhaust ductwork and all plenums serving common spaces are sealed at all transverse joints, longitudinal seams, and duct wall penetrations with mastic, mastic tape, or internal aerosol-based sealant.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.7 Duct leakage of central exhaust systems that serve four or more dwelling units, meets one of the following two options:				
6.7.1 <u>Rough-in</u> : Tested including horizontal run outs, trunks, branches, and take-offs up to, but not including, the grilles, the leakage does not exceed 25% of exhaust fan flow. ⁵³	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.7.2 <u>Final</u> : Tested inclusive of all ductwork between the fan and the grilles, the leakage does not exceed 30% of exhaust fan flow. ⁵³	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



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7. Dwelling-Unit & Common Space Mechanical Ventilation System (National HVAC Design Report Item # indicated in parenthesis)				Must Correct	Rater Verified ⁴	N/A ⁵
7.1 Ventilation manufacturer & model number on installed equipment matches either of the following (check box): ⁴¹ <input type="checkbox"/> National HVAC Design Report <input type="checkbox"/> Written approval received from designer				<input type="checkbox"/>	<input type="checkbox"/>	-
7.2 Rater-measured ventilation rate is within either ± 15 CFM or $\pm 15\%$ of dwelling unit design values (2.7), and meets or exceeds rates required by ASHRAE 62.2-2010. ⁵⁴				<input type="checkbox"/>	<input type="checkbox"/>	-
7.3 Measured ventilation rate is within either ± 15 CFM or $\pm 15\%$ of common space design values (2.9), and meets or exceeds rates required by ASHRAE 62.1-2010 (2.8). ⁵⁵				<input type="checkbox"/>	<input type="checkbox"/>	-
7.4 A ventilation override control installed and also labeled if its function is not obvious (e.g., a label is required for a standalone wall switch, but not for a switch that's on the ventilation equipment). Townhouses only: Ventilation override control is readily accessible to the occupant.				<input type="checkbox"/>	<input type="checkbox"/>	-
7.5 No outdoor air intakes connected to return side of the dwelling unit HVAC system, unless controls are installed to operate intermittently & automatically based on a timer and to restrict intake when not in use (e.g., motorized damper).				<input type="checkbox"/>	<input type="checkbox"/>	-
7.6 If located in the dwelling unit, system fan rated ≤ 3 sones if intermittent, ≤ 2 sones if continuous, or exempted. ⁵⁶				<input type="checkbox"/>	<input type="checkbox"/>	-
7.7 If system utilizes the dwelling unit HVAC fan, then the installed fan type is ECM / ICM (4.12), or the controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling.				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.8 In-unit bathroom fans or in-line fans are ENERGY STAR certified if used as part of the dwelling-unit mechanical ventilation system. ⁵⁷				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.9 If central exhaust fans, ≤ 1 HP, are installed as part of the dwelling-unit mechanical ventilation system, then they are direct-drive, ECM, with variable speed controllers. If > 1 HP, they are installed with NEMA TM Premium Motors.				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.10 Air inlet locations (Complete if ventilation air inlet locations were installed (2.22, 2.23); otherwise check "N/A"): ^{58, 59}				-	-	<input type="checkbox"/>
7.10.1 Inlet(s) pull ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit.				<input type="checkbox"/>	<input type="checkbox"/>	-
7.10.2 Inlet(s) are ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources not exiting the roof, and ≥ 3 ft. distance from dryer exhausts and sources exiting the roof. ⁶⁰				<input type="checkbox"/>	<input type="checkbox"/>	-
7.10.3 Inlet(s) are provided with rodent / insect screen with ≤ 0.5 inch mesh.				<input type="checkbox"/>	<input type="checkbox"/>	-
8. Local Mechanical Exhaust (National HVAC Design Report Item # indicated in parenthesis)						
Dwelling Unit Mechanical exhaust - In each dwelling unit kitchen and bathroom, a system is installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow and manufacturer-rated sound level standards: ^{54, 61}						
Location		Continuous Rate	Intermittent Rate ⁶²	Must Correct	Rater Verified ⁴	N/A ⁵
8.1 Kitchen	Airflow	≥ 5 ACH, based on kitchen volume ^{63, 64}	≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume ^{63, 64, 65}	<input type="checkbox"/>	<input type="checkbox"/>	-
	Sound	Recommended: ≤ 1 sone	Recommended: ≤ 3 sones			
8.2 Bathroom	Airflow	≥ 20 CFM	≥ 50 CFM	<input type="checkbox"/>	<input type="checkbox"/>	-
	Sound	Required: ≤ 2 sones	Recommended: ≤ 3 sones			
Mechanical Exhaust for Common Spaces ² and Shared Garages						
8.3 Measured exhaust rates are \geq ASHRAE 62.1 rates (2c). ⁵⁵				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.4 Where an exhaust system is installed in a shared garage, it is equipped with controls that sense CO and NO ₂ .				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Filtration						
9.1 MERV 6+ filter(s) installed in each ducted mechanical system serving an individual dwelling unit and located to facilitate access & regular service by the occupant or building owner. ⁶⁶				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.1.1 Filter access panel includes gasket and fits snugly against the exposed edge of filter when closed to prevent bypass. ⁶⁷				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.1.2 All return air and mechanically supplied outdoor air passes through filter prior to conditioning.				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Combustion Appliances						
10.1 Furnaces, boilers, and water heaters located within the building's pressure boundary are mechanically drafted or direct-vented. If mechanically drafted, the minimum volume of combustion air required for safe operation by the manufacturer and/or code shall be met or exceeded and make-up air sources must be mechanically closed when the combustion appliance is not in operation. Alternatives in Footnote 70. ^{68, 69, 70}				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.2 Fireplaces located within the building's pressure boundary are direct-vented. ^{68, 69}				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.3 No unvented combustion appliances other than cooking ranges or ovens are located inside the building's pressure boundary. For cooking ranges and ovens, local mechanical exhaust per Checklist Item 8.1 requirements must be met. ⁶⁸				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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Other	Must Correct	LP Verified ⁴⁴	Rater Verified ⁴	N/A ⁵
11. Domestic Hot Water				
11.1 Prescriptive Path: Hot water equipment rated in EF or UEF meet the efficiency levels specified in the ENERGY STAR Multifamily Reference Design. Otherwise, meet or exceed 85% Et. ⁷¹	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
11.2 ERI: For hot water equipment serving common spaces but not dwelling units nor shared laundry: where rated in EF or UEF, meet the efficiency levels specified in the ENERGY STAR Multifamily Reference Design. Otherwise, meet or exceed 85% Et. ⁷¹	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
11.3 For in-unit storage water heaters, AHRI Certificate confirms the presence of a heat trap.	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
11.4 DHW piping located in the dwelling unit is insulated with a minimum of R-3. ⁷²	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
11.5 Rater-measured delivery temperatures at faucets and showerheads do not exceed 125°F. ⁷³	<input type="checkbox"/>	-	<input type="checkbox"/>	-
12. Lighting				
12.1 Common Space ² Lighting Controls:				
12.1.1 ERI and Prescriptive Path: All common spaces ² (including shared garages), except the building lobby and where automatic shutoff would endanger the safety of occupants, have occupancy sensors or automatic bi-level lighting controls installed and operation has been verified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.1.2 ASHRAE Path only: All common spaces ² (including shared garages), except the building lobby, corridors, and stairwells and where automatic shutoff would endanger the safety of occupants, have occupancy sensors or automatic bi-level lighting controls installed and operation has been verified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.2 Common Space ² Lighting Power Density Maximum (except garages): ⁷⁴				
12.2.1 ERI and Prescriptive Path: Total installed lighting power for the combined common spaces ² must not exceed ASHRAE 90.1-2007 allowances for those combined spaces, using the Space-by-Space or Building Area Method. See Footnote 75 for allowances. ⁷⁵	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.2.2 ASHRAE Path only: Total installed lighting power for the combined common spaces ² must not exceed ASHRAE 90.1-2007 allowances for those combined spaces, using the Space-by-Space or Building Area Method, by more than 20%. See Footnote 75 for allowances. ⁷⁵	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.3 Shared garages: Lighting power density does not exceed 0.24 W/ft ² .	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.4 Exterior lighting controls: Fixtures, including parking lot fixtures, must include automatic switching on timers or photocell controls except fixtures intended for 24-hour operation, required for security, or located on dwelling unit balconies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.5 ERI Path: All exterior and common space lighting fixtures meet the efficiency requirements in the ENERGY STAR Multifamily Reference Design, except fixtures located on dwelling unit balconies. ^{76, 77}	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
12.6 Prescriptive Path: All lighting fixtures (i.e., dwelling units, common spaces, and exterior) meet the efficiency requirements in the ENERGY STAR Multifamily Reference Design. ^{76, 77}	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
12.7 Prescriptive Path: Dwelling unit overall in-unit lighting power density ≤ 0.75 W/ft ² . When calculating overall lighting power density, use 1.1 W/ft ² where lighting is not installed. ⁷⁴	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>
13. Appliances and Plumbing Fixtures		Must Correct	Rater Verified ⁴	N/A ⁵
13.1 Prescriptive Path: Installed appliances are ENERGY STAR certified. Installed bathroom faucets, bathroom aerators, and showerheads are WaterSense labeled. ⁷⁸		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.2 ERI Path: Where installed in common spaces, refrigerators and dishwashers are ENERGY STAR certified and showerheads are WaterSense labeled.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.3 Prescriptive Path: Shower compartments with multiple fixtures cannot be operated simultaneously OR the total flow rate per shower compartment must not exceed 1.75 gallons per minute, as rated at 80 psi.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Whole Building Energy Consumption Data Acquisition Strategy				
14.1 For buildings 50,000 ft ² and larger, a strategy that enables the collection of monthly or annual building-level energy consumption data (electricity, natural gas, chilled water, steam, fuel oil, propane, etc.) has been confirmed. ⁷⁹		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rater Name: _____ Rater Pre-Drywall Inspection Date(s): _____ Rater Initials: _____				
Rater Company Name: _____				
Rater Name: _____ Rater Final Inspection Date(s): _____ Rater Initials: _____				
Rater Company Name: _____				
Builder/Developer Employee: _____ Builder Inspection Date(s): _____ Builder Initials: _____				
Builder/Developer Name: _____				
Licensed Professional: _____ LP Inspection Date(s): _____ LP Initials: _____				



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Footnotes:

1. This Checklist applies to all dwelling units, sleeping units, common spaces², and garages (open or enclosed) in the building being certified, and where specified, parking lots. These requirements do not apply to parking garages or lots where the cost of the energy use of the parking garage or lot is not the responsibility of the Builder/Developer, Building Owner or Property Manager. This Checklist does not apply to commercial or retail spaces. This Checklist does not apply to common spaces² that are located in buildings on the property without any dwelling or sleeping units. The term 'sleeping unit' refers to a room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Where the term 'dwelling unit' is used in this Checklist, the requirement is also required of 'sleeping' units. The term 'building' refers to a structure utilized or intended for supporting or sheltering occupancy for a residential purpose; a structure with no dwelling or sleeping units connected to a structure with dwelling or sleeping units by less than 10% of its exterior wall area is not to be included in the 'building'.
2. The term 'common space' refers to any spaces in the building being certified that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, and dining halls, as well as offices and other spaces used by building management, administration or maintenance in support of the residents.
3. At the discretion of the Rater, the builder or developer may verify up to eight items in Sections 1-4 of this Checklist. For the purpose of this Checklist, "Builder" represents either the builder or the developer. When exercised, the builder's responsibility will be formally acknowledged by the builder, or their designated agent, signing off on the checklist for the item(s) that they verified. However, if a quality assurance review indicates that Items have not been successfully completed, the Rater will be responsible for facilitating corrective action.
4. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater, Approved Inspector, as defined by ANSI / RESNET / IECC Standard 301, or an equivalent designation as determined by a Home Certification Organization (HCO) or Multifamily Review Organization (MRO); and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/mftraining.
5. The column titled "N/A," which denotes items that are "not applicable," should be used when the checklist Item is not present in the project or conflicts with local requirements.
6. Two alternatives are provided: a) Grade II cavity insulation is permitted to be used for assemblies that contain a layer of continuous, air impermeable insulation $\geq R-3$ in Climate Zones 1 to 4, $\geq R-5$ in Climate Zones 5 to 8; b) Grade II batts are permitted to be used in floors if they fill the full width and depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving Grade I is the compression caused by the excess insulation.
7. Ensure compliance with this requirement using ANSI / RESNET / ICC Std. 301 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is certified under, with approved exceptions listed at www.energystar.gov/ERIEExceptions.
8. Window-to-Wall ratio is taken as the sum of all window area divided by the total exterior above-grade wall area. All decorative glass and skylight window area contribute to the total window area to above-grade wall ratio (WWR). Spandrel sections of curtain wall systems contribute to the above-grade wall area.
9. Compliance with Items 1.5 and 1.6 is not required for ASHRAE projects, but the energy used by the heating systems must be modeled following the requirements in the Simulation Guidelines, available at www.energystar.gov/mfguidance.
10. The bottom of the heated plenum is permitted to be suspended ceiling tiles or other non-air barrier material. If fiberglass insulation is installed, it must be paper-faced. This insulation shall achieve a Grade I or Grade II install.
11. For purposes of this Checklist, an air barrier is defined as any durable solid material that blocks air flow between conditioned space and unconditioned space, including necessary sealing to block excessive air flow at edges and seams and adequate support to resist positive and negative pressures without displacement or damage. EPA recommends, but does not require, rigid air barriers.
Open-cell or closed-cell foam shall have a finished thickness ≥ 5.5 in. or 1.5 in., respectively, to qualify as an air barrier unless the manufacturer indicates otherwise.
If flexible air barriers such as house wrap are used, they shall be fully sealed at all seams and edges and supported using fasteners with caps or heads ≥ 1 in. diameter unless otherwise indicated by the manufacturer. Flexible air barriers shall not be made of kraft paper, paper-based products, or other materials that are easily torn. If polyethylene is used, its thickness shall be ≥ 6 mil.
12. All insulated ceiling surfaces, regardless of slope (e.g., cathedral ceilings, tray ceilings, conditioned attic roof decks, flat ceilings, sloped ceilings), must meet the requirements for ceilings, unless the ceiling is adiabatic.
13. All insulated vertical surfaces are considered walls (e.g., above and below grade exterior walls, knee walls) and must meet the air barrier requirements for walls. The following exceptions apply: air barriers recommended, but not required, in adiabatic walls; and, in Climate Zones 4 through 8, an air barrier at the interior vertical surface of insulation is recommended but not required in basement walls or crawlspace walls. For the purpose of these exceptions, a basement or crawlspace is a space for which $\geq 40\%$ of the total gross wall area is below-grade.
14. EPA highly recommends, but does not require, an air barrier at the interior vertical surface of floor insulation in Climate Zones 4-8.
15. Examples of supports necessary for permanent contact include staves for batt insulation or netting for blown-in insulation. Alternatively, supports are not required if batts fill the full depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving the required installation grade is the compression caused by the excess insulation.
16. Alternatively, an air barrier is permitted to be installed at the exterior horizontal surface of the floor insulation if the insulation is installed in contact with this air barrier, the exterior vertical surfaces of the floor cavity are also insulated, and air barriers are included at the exterior vertical surfaces of this insulation.
17. The minimum designated R-values must be achieved regardless of the trade-offs determined using an equivalent U-factor or UA alternative calculation. Note that if the minimum designated values are used, then higher insulation values may be needed elsewhere to meet Item 1.2.



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Also, note that these requirements can be met by using any available strategy, such as a raised-heel truss, alternate framing that provides adequate space, and / or high-density insulation.

18. Examples of durable covers include, but are not limited to, pre-fabricated covers with integral insulation, rigid foam adhered to cover with adhesive, or batt insulation mechanically fastened to the cover (e.g., using bolts, metal wire, or metal strapping). Low-slope roof hatch covers to be insulated to R-5 minimum.
19. Consistent with the 2009 IECC, slab edge insulation is only required for slab-on-grade floors with a floor surface less than 24 inches below grade. Slab-on-grade perimeter insulation shall extend to the top of the slab to provide a complete thermal break. If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall. Alternatively, the thermal break is permitted to be created using \geq R-3 rigid insulation on top of an existing slab (e.g., in a building undergoing a gut rehabilitation). In such cases, up to 10% of the slab surface is permitted to not be insulated (e.g., for sleepers, for sill plates). Insulation installed on top of slab shall be covered by a durable floor surface (e.g., hardwood, tile, carpet).
20. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the building, slab perimeter insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab, if the slab is in contact with the ground at that interface. Where specific details cannot meet this requirement, partners shall provide the detail to EPA to request an exemption prior to the building's certification. EPA will compile exempted details and work with industry to develop feasible details for use in future revisions to the program. A list of currently exempted details is available at: www.energystar.gov/slabeledge.
21. For projected balconies, install a minimum of R-5 slab edge insulation to provide a thermal break between conditioned space and the unconditioned projected balcony slab. Alternatively, a UA calculation for the wall assembly that accounts for this projected slab must be performed to demonstrate compliance with Item 1.2. For the purpose of this UA calculation, the area of the wall that is uninsulated due to the projected balcony is required to be calculated as 400% of that actual area. For example, for a projected balcony without any thermal break that is 20 feet wide, and has a thickness of 1 foot, the area to be used in the UA calculation is 80 ft² instead of 20 ft². For thermal breaks R-2 and greater, the area is not required to be modified. The distance the balcony projects from the building is not used in this calculation.

For podiums that are less than 8ft in height, insulation must be installed for the full height of the podium. For podiums that continue below-grade, insulate to a minimum of 8ft below the bottom of the slab edge, or to the depth below-grade specified for slab edge insulation by Table 502.2(1) of the 2009 IECC. For podiums, where insulation is installed on both interior and exterior surfaces of the wall, insulation depth may be reduced to 4ft.

22. Whether insulating from above or below the slab, thermal breaks must be accounted for when determining compliance with floor U-factors. Where structural columns cause a discontinuity in the installed floor insulation, the UA calculation for the floor assembly must account for this uninsulated area of the floor. For the purpose of this UA calculation, the area of the floor that is uninsulated due to the structural columns is required to be calculated as 400% of that actual area. For example, for a 4'x4' column, the area to be used in the UA calculation is 64 ft² instead of 16 ft². The height of the column is not used in this calculation. Alternatively, if the structural column is insulated for a minimum of 4 vertical feet, the modification to the UA calculation is not required, and the U-value of the column insulation shall be associated with the uninsulated area of the floor due to the column.
23. Item 3.7 is applicable to walls that are adjacent to other buildings. Mass walls utilized as the thermal mass component of a passive solar design (e.g., a Trombe wall) are exempt from this Item. To be eligible for this exemption, the passive solar design shall be comprised of the following five components: an aperture or collector, an absorber, thermal mass, a distribution system, and a control system. For more information, see: www.energy.gov/sites/prod/files/guide_to_passive_solar_home_design.pdf.

Mass walls that are not part of a passive solar design (e.g., CMU block or log home enclosure) shall either utilize the strategies outlined in Item 3.7 or the pathway in the assembly with the least thermal resistance, as determined using a method consistent with the 2013 ASHRAE Handbook of Fundamentals, shall provide \geq 50% of the applicable assembly resistance, defined as the reciprocal of the mass wall equivalent U-factor in the 2009 IECC Table 502.1.2. Documentation identifying the pathway with the least thermal resistance and its resistance value shall be collected by the Rater and any Builder Verified or Rater Verified box under Item 3.7 shall be checked.

24. Up to 10% of the total exterior wall surface area is exempted from the reduced thermal bridging requirements to accommodate intentional designed details (e.g., architectural details such as thermal fins, wing walls, brick returns, stone window sills, metal panels, or masonry fireplaces; structural details, such as fasteners (e.g., shelf angles, metal clips, z-girts, brick ties), projected balconies, and service openings (e.g., PTACs or PTHPs), but not steel columns or wall area occupied by intermediate floors). It shall be apparent to the Rater that the exempted areas are intentional designed details or the exempted area shall be documented in a plan provided by the builder, architect, or engineer. The entire area of the wall area that is bypassed by the fastener must be used in the calculation. The Rater need not evaluate the necessity of the designed detail to certify the project.
25. If used, insulated siding shall be attached directly over a water-resistive barrier and sheathing. In addition, it shall provide the required R-value as demonstrated through either testing in accordance with ASTM C 1363 or by attaining the required R-value at its minimum thickness. Insulated sheathing rated for water protection can be used as a water resistant barrier if all seams are taped and sealed. If non-insulated structural sheathing is used at corners, the advanced framing details listed in Item 3.7.3 shall be met for those wall sections.
26. Walls and rim / band joists using steel or other metal framing shall meet the reduced thermal bridging requirements by complying with Item 3.7.1 of the Checklist and may not demonstrate compliance using Item 3.7.2 or 3.7.3.
27. In a building undergoing a gut rehabilitation, continuous interior insulation may be used in lieu of continuous exterior rigid insulation or insulated siding. This alternative does not require continuous interior insulation where a floor intersects an exterior wall, it only requires it from floor to ceiling. Continuous interior insulation is required where the demising wall intersects the exterior wall; however, it may be exempted per Footnote 24.
28. Double-wall framing is defined as any framing method that ensures a continuous layer of insulation covering the studs to at least the R-value required in Item 3.7.1 of the Checklist, such as offset double-stud walls, aligned double-stud walls with continuous insulation between the adjacent stud faces, or single-stud walls with 2x2 or 2x3 cross-framing. In all cases, insulation shall fill the entire wall cavity from the interior to exterior sheathing except at windows, doors and other penetrations.
29. Rim / band joists are exempt from this requirement. For the purpose of this requirement, " \leq 3 stories" refers to any portion of the building elevation where the wood-framed walls do not exceed 3 stories in height. Partial floors that meet the definition of a mezzanine or loft, as defined by the 2012 IRC, do not count as a story. All 'advanced framing' details shall be met except where the builder, architect, or engineer



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provides a framing plan that encompasses the details in question, indicating that structural members are required at these locations and including the rationale for these members (e.g., full-depth solid framing is required at wall corners or interior / exterior wall intersections for shear strength, a full-depth solid header is required above a window to transfer load to jacks studs, additional jack studs are required to support transferred loads, additional cripple studs are required to maintain on-center spacing, or stud spacing must be reduced to support multiple stories in a multifamily building). The Rater shall retain a copy of the detail and rationale for their records, but need not evaluate the rationale to certify the building.

30. All exterior corners shall be constructed to allow access for the installation of \geq R-6 insulation that extends to the exterior wall sheathing. Examples of compliance options include standard-density insulation with alternative framing techniques, such as using three studs per corner, or high-density insulation (e.g., spray foam) with standard framing techniques.
31. Compliance options include continuous rigid insulation sheathing, SIP headers, other prefabricated insulated headers, single-member or two-member headers with insulation either in between or on one side, or an equivalent assembly. R-value requirement refers to manufacturer's nominal insulation value.
32. Insulation shall run behind interior / exterior wall intersections using ladder blocking, full length 2x6 or 1x6 furring behind the first partition stud, drywall clips, or other equivalent alternative.
33. In Climate Zones 1 through 3, a continuous stucco cladding system sealed to windows and doors is permitted to be used in lieu of sealing rough openings with caulk or foam.
34. For dwelling or sleeping units adjacent to garages, EPA recommends, but does not require, carbon monoxide (CO) alarms installed in a central location in the immediate vicinity of each separate sleeping zone and according to NFPA 720.
35. Where a sampling protocol is permitted in accordance with the National or California Program Requirements, at least 20% of the dwelling or sleeping units adjacent to a garage shall be selected for testing.
36. A 'ducted return' is defined as a continuous duct made of sheet metal, duct board, or flexible duct that connects one or more return grilles to the return-side inlet of the air handler. Any other approach to convey air from return or transfer grille(s) to the air handler, such as the use of building cavities, does not constitute a 'ducted return'.
37. This section of the Checklist is designed to meet the requirements of ASHRAE 62.1-2010 / 2013, ASHRAE 62.2-2010 / 2013, and ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new multifamily buildings when compared to multifamily buildings built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems, (e.g., those caused by a lack of maintenance or by occupant behavior). Therefore, this Checklist is not a guarantee of proper ventilation, indoor air quality, or HVAC performance.
38. Two tracks are provided for satisfying the mandatory requirements for all certified buildings, Exhibit 2. Track A – HVAC Grading by Rater allows a Rater to utilize ANSI / RESNET / ACCA Std. 310³⁹, a standard for grading the installation of residential HVAC systems, for all applicable systems serving individual dwelling units or common spaces, and a Functional Testing Agent to verify commercial and central systems. Track B – HVAC Testing by FT Agent utilizes a Functional Testing Agent for all systems. Either path may be selected, but all requirements within that path must be satisfied for the building to be certified.
39. Track A – HVAC Grading by Rater shall not be used until an implementation schedule has been defined for ANSI / RESNET / ACCA Std. 310 by the HCO or MRO that the building is being certified under. Track A – HVAC Grading by Rater shall then use ANSI / RESNET / ACCA Std. 310 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is being certified under. For Track A, unitary HVAC Systems including air conditioners and heat pumps up to 65 kBtuh and furnaces up to 125 kBtuh serving individual dwelling or sleeping units or common spaces shall comply with 5a.1 through 5a.3 for the building to be certified.
40. If the non-invasive procedure in ANSI / RESNET / ACCA Std. 310 is not permitted to be used during the final inspection of a unit (i.e., due to the equipment type or to outdoor air temperatures that do not meet the requirements of the non-invasive method), then the unit is permitted to be certified with a default refrigerant charge designation of Grade III. Note that in these circumstances, the weigh-in method procedure in ANSI / RESNET / ACCA Std. 310 may still be used to pursue a Grade I designation.
41. If installed equipment does not match the National HVAC Design Report, then prior to certification the Rater shall obtain written approval from the designer (e.g., email, updated National HVAC Design Report) confirming that the installed equipment meets the requirements of the National HVAC Design Report. In addition, the Rater shall verify that all installed equipment are still exempted types per Footnote 20 of the National HVAC Design Report or, if no longer an exempted type, shall re-review Section 4b of the National Rater Design Review Checklist to ensure compliance with all requirements (e.g., full completion of HVAC Design Report, HVAC design tolerances). In cases where the condenser unit is installed after the time of inspection by the Rater, the HVAC manufacturer and model numbers on installed equipment can be documented through the use of photographs provided by the HVAC Contractor or Functional Testing Agent after installation is complete.
42. The Rater shall measure and record the external static pressure in the return-side and supply-side of the system using the contractor-provided test locations. However, at this time, the Rater need not assess whether these values are within a specific range to certify the dwelling unit. Ductless systems and systems with a total amount of supply ductwork or distribution building cavities \leq 10 ft. in length are exempted from this requirement. The Rater is also not required to measure external static pressure for multi-split systems and may mark "N/A".
43. Functional Testing Agents must hold an approved credential, as listed at www.energystar.gov/ftas, or must be a representative of the Original Equipment Manufacturer (OEM), or a contractor credentialed by an HVAC Quality Installation Training and Oversight Organization (H-QUITO), if not completing Sections 6 and higher. Functional Testing Agents may not be the installing contractor, nor employed by the same company as the installing contractor, unless they are a credentialed contractor. An explanation of the credentialing process and links to H-QUITOs, which maintain lists of credentialed contractors, can be found at www.energystar.gov/findhvac. A directory of other FT Agents can be found at www.energystar.gov/ftas. Raters can confirm FT Agents have met the requirements by documenting they are listed in a directory. For Track A, a Functional Testing Agent is not needed to complete Sections 2 and 3 for residential HVAC systems serving dwelling units or common spaces that will be verified and graded by the Rater.
44. At the discretion of the Rater, a Licensed Professional (LP), (i.e., a Registered Architect or Professional Engineer in good standing and with a current license), may verify any of the items in Sections 5, 11, and 12 of this Checklist, where a checkbox is provided for "LP Verified". When exercised, the LP's responsibility will be formally acknowledged by the LP signing off on the checklist for the item(s) that they verified.



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However, if a quality assurance review indicates that Items have not been successfully completed, the Rater will be responsible for facilitating corrective action.

45. Kinks are to be avoided and are caused when ducts are bent across sharp corners such as framing members. Sharp bends are to be avoided and occur when the radius of the turn in the duct is less than one duct diameter. Compression is to be avoided and occurs when flexible ducts in unconditioned space are installed in cavities smaller than the outer duct diameter and ducts in conditioned space are installed in cavities smaller than inner duct diameter. Ducts shall not include coils or loops except to the extent needed for acoustical control.
46. Item 6.2 does not apply to ventilation ducts, exhaust ducts, or non-ducted systems. For an HVAC system with a multi-speed fan, the highest design fan speed shall be used when verifying this requirement. When verifying this requirement, doors separating bedrooms from the main body of the dwelling unit (e.g., a door between a bedroom and a hallway) shall be closed and doors to rooms that can only be entered from the bedroom (e.g., a closet, a bathroom) shall be open. The Rater-measured pressure shall be rounded to the nearest whole number to assess compliance.
47. Item 6.3 does not apply to ducts that are a part of local mechanical exhaust or exhaust-only dwelling-unit mechanical ventilation systems. EPA recommends, but does not require, that all metal ductwork not encompassed by Section 6 (e.g., exhaust ducts, duct boots, ducts in conditioned space) also be insulated and that insulation be sealed to duct boots to prevent condensation.
48. Items 6.4 and 6.5 generally apply to the ducts of space heating, space cooling, and dwelling-unit mechanical ventilation systems.

However, visual inspection is permitted in lieu of testing for the following system types: 1) a dwelling-unit mechanical ventilation system not connected to the space heating or space cooling system, regardless of the number of dwelling units it serves; 2) a space heating or space cooling system for which the ducts and air handler are in conditioned space and the total supply duct length of the system, including all supply trunks and branches, is ≤ 10 ft; and 3) a space heating or space cooling system that serves more than one dwelling unit. In such cases, a Rater shall visually verify that all seams and connections are sealed with mastic or metal tape and all duct boots are sealed to floor, wall, or ceiling using caulk, foam, or mastic tape.

For duct systems requiring testing, duct leakage shall be determined and documented by a Rater using ANSI / RESNET / ICC Std. 380 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is being certified under. Leakage limits shall be assessed on a per-system, rather than per-dwelling unit, basis.

49. Note that compliance with Item 6.4.1 or 6.4.2 in conjunction with Section 4a of the National Rater Design Review Checklist automatically achieves Grade I total duct leakage per ANSI / RESNET / ACCA Std. 310.
50. Cabinets (e.g., kitchen, bath, multimedia) or ducts that connect duct boots to toe-kick registers are not required to be in place during the 'rough-in' test.
51. Registers atop carpets are permitted to be removed and the face of the duct boot temporarily sealed during testing. In such cases, the Rater shall visually verify that the boot has been durably sealed to the subfloor (e.g., using duct mastic or caulk) to prevent leakage during normal operation.
52. Testing of duct leakage to the outdoors can be waived in accordance with the 2nd or 3rd alternative of ANSI / RESNET / ICC Std. 301, Table 4.2.2 (1), footnote (w). Alternatively, testing of duct leakage to outdoors can be waived in accordance with Section 5.5.2 of ANSI / RESNET / ICC Std. 380 if total duct leakage, at rough-in or final, is ≤ 4 CFM25 per 100 sq. ft. of conditioned floor area or 40 CFM25, whichever is larger. Guidance to assist partners with these alternatives, including modeling inputs, is available at www.energystar.gov/newhomesguidance.
53. For the purpose of computing leakage allowance, exhaust fan flow shall be the lesser of the rated fan flow and at rough-in, 133% of the sum of the design exhaust airflow of the dwelling units that are exhausted by that central fan or at final, 143% of the sum of the design exhaust airflow of the dwelling units that are exhausted by that central fan. Measured fan flow (either at the fan itself or the total airflow measured from all exhaust grilles served by the fan) may be used in lieu of the rated fan flow to determine the leakage allowance. Duct leakage shall be tested at the design or average operating pressure and shall use the procedures in the *RESNET Guidelines for Multifamily Energy Ratings*, available at www.resnet.us/blog/resnet-adopts-guidelines-for-multifamily-energy-ratings/. Where testing at the design or average operating pressure is not feasible, testing at 50 Pa is permitted, however the following flow equation must be used to determine the leakage allowance at 50 Pa.

$$CFM_{50} = CFM_{design} / [P_{design}^{(0.65)} / 50^{(0.65)}]$$

No less than 50% of the ductwork, based on total linear feet, shall be tested and must include ductwork other than the main trunks. Where portions of ductwork are tested, rather than entire risers, the percentage of leakage allowed is based upon the design airflow of the dwelling units that are exhausted in that portion. Where failures occur, the percentage of total linear feet required to be tested increases by 10%. Where aerosol-based sealant is used on some but not all risers, the ductwork selected for testing must be representative of all sealing strategies used. This test is not required of central exhaust systems serving clothes dryers.

54. The dwelling-unit ventilation air flow and local exhaust air flows shall be determined and documented by a Rater using ANSI / RESNET / ICC Std. 380 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is being certified under. In Item 7.2, the dwelling-unit ventilation rates required by ASHRAE 62.2-2010 can be calculated using the Multifamily Workbook or the following equation: $0.01 \times \text{Conditioned Floor Area} + 7.5 \times (\text{number of bedrooms} + 1)$. Where local codes do not permit dwelling-unit ventilation to exceed ASHRAE 62.2-2010 rates, Rater-measured ventilation rate is permitted to be 0-15 CFM less than rates required by ASHRAE 62.2-2010.
55. While common spaces are not under the scope of ANSI / RESNET / ICC Std. 380, the ventilation air flow and exhaust air flows in common spaces shall be measured in accordance with the procedures in ANSI / RESNET / ICC Std. 380. The air flows may be measured by a Rater or a certified air-balancing contractor under the observation of a Rater. Where a system provides supply air that is a mix of return and outdoor air, and not 100% outdoor air, the outdoor air intake airflow shall be measured and compared to the total supply airflow to determine percentage of outdoor air supplied. This percentage shall be applied to airflow measured at supply registers to determine outdoor air provided for comparison to design airflow rates.
56. Dwelling-unit mechanical ventilation fans shall be rated for sound at no less than the airflow rate in Item 2.7 of the National HVAC Design Report. Fans exempted from this requirement include HVAC air handler fans, remote-mounted fans, and intermittent fans rated ≥ 400 CFM. To be considered for this exemption, a remote-mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways and there shall be ≥ 4 ft. ductwork between the fan and intake grille. Per ASHRAE 62.2-2010, habitable spaces are intended for continual



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human occupancy; such space generally includes areas used for living, sleeping, dining, and cooking but does not generally include bathrooms, toilets, hallways, storage areas, closets, or utility rooms.

57. Bathroom fans with a rated flow rate ≥ 500 CFM are exempted from the requirement to be ENERGY STAR certified.
58. Ventilation air inlets that are only visible via rooftop access are exempted from Item 7.10 and the Rater shall mark "N/A". The outlet and inlet of balanced ventilation systems shall meet these spacing requirements unless manufacturer instructions indicate that a smaller distance may be used. However, if this occurs the manufacturer's instructions shall be collected for documentation purposes.
59. Without proper maintenance, ventilation air inlet screens often become filled with debris. Therefore, EPA recommends, but does not require, that these ventilation air inlets be located so as to facilitate access and regular service by the building owner.
60. Known contamination sources include, but are not limited to, stacks, vents, exhausts, and vehicles.
61. Continuous bathroom local mechanical exhaust fans shall be rated for sound at no less than the airflow rate in Item 8.2. Intermittent bathroom and both intermittent and continuous kitchen local mechanical exhaust fans are recommended, but not required, to be rated for sound at no less than the airflow rate in Items 8.1 and 8.2. Per ASHRAE 62.2-2010, an exhaust system is one or more fans that remove air from the building, causing outdoor air to enter by ventilation inlets or normal leakage paths through the building envelope (e.g., bath exhaust fans, range hoods, clothes dryers). Per ASHRAE 62.2-2010, a bathroom is any room containing a bathtub, shower, spa, or similar source of moisture.
62. An intermittent mechanical exhaust system, where provided, shall be designed to operate as needed by the occupant. Control devices shall not impede occupant control in intermittent systems.
63. Kitchen volume shall be determined by drawing the smallest possible rectangle on the floor plan that encompasses all cabinets, pantries, islands, peninsulas, ranges / ovens, and the kitchen exhaust fan, and multiplying by the average ceiling height for this area. In addition, the continuous kitchen exhaust rate shall be ≥ 25 CFM, per 2009 IRC Table M1507.3, regardless of the rate calculated using the kitchen volume. Cabinet volume shall be included in the kitchen volume.
64. Alternatively, the prescriptive duct sizing requirements in Table 5.3 of ASHRAE 62.2-2010 are permitted to be used for kitchen exhaust fans based upon the rated airflow of the fan at 0.25 IWC. If the rated airflow is unknown, ≥ 6 in. smooth duct shall be used, with a rectangular to round duct transition as needed. Guidance to assist partners with these alternatives is available at www.energystar.gov/newhomesguidance. As an alternative to Item 8.1, dwelling units are permitted to use a continuous kitchen exhaust rate of 25 CFM per 2009 IRC Table M1507.3, if they are either a) PHIUS+ or PHI certified, or b) provide both dwelling-unit ventilation and local mechanical kitchen exhaust using a balanced system, and have a Rater-verified whole-building infiltration rate ≤ 1.0 ACH50 or ≤ 0.05 CFM50 per sq. ft. of Enclosure Area. 'Enclosure Area' is defined as the area of the surfaces that bound the volume being pressurized / depressurized during the test.
65. All intermittent kitchen exhaust fans must be capable of exhausting at least 100 CFM. In addition, if the fan is not part of a vented range hood or appliance-range hood combination (i.e., if the fan is not integrated with the range), then it must also be capable of exhausting ≥ 5 ACH, based on the kitchen volume.
66. Based upon, ASHRAE 62.2-2010, ducted mechanical systems are those that supply air to an occupiable space with a total amount of supply ductwork exceeding 10 ft. in length and through a thermal conditioning component, except for evaporative coolers. Systems that do not meet this definition are exempt from this requirement. While filters are recommended for mini-split systems, HRV's, and ERV's, these systems, ducted or not, typically do not have MERV-rated filters available for use and are, therefore, also exempted under this version of the requirements. HVAC filters located in the attic shall be considered accessible to the occupant or building owner if either 1) drop-down stairs, a pull-down ladder, or door provide access to attic and a permanently installed walkway has been provided between the attic access location and the filter or 2) the filter location enables arm-length access from a portable ladder without the need to step into the attic and the height of the ceiling access panel or the bottom of the wall access panel where access is provided is ≤ 12 ft.
67. Sealing mechanisms comparable to a gasket are also permitted to be used. The filter media box (i.e., the component in the HVAC system that houses the filter) may be either site-fabricated by the installer or pre-fabricated by the manufacturer to meet this requirement. These requirements only apply when the filter is installed in a filter media box located in the HVAC system, not when the filter is installed flush with the return grille.
68. The pressure boundary is the primary enclosure boundary separating indoor and outdoor air. For example, a volume that has more leakage to outside than to conditioned space would be outside the pressure boundary.
69. Per the 2009 International Mechanical Code, a direct-vent appliance is one that is constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outside atmosphere; a mechanical draft system is a venting system designed to remove flue or vent gases by mechanical means consisting of an induced draft portion under non-positive static pressure or a forced draft portion under positive static pressure; and a natural draft system is a venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.
70. Naturally drafted equipment is only allowed if located in a space outside the pressure boundary, where the envelope assemblies separating it from conditioned space are insulated and air-sealed.
71. Where water heater efficiency is rated in Uniform Energy Factor (UEF) rather than Energy Factor (EF), the EF may be calculated from the Uniform Energy Factor (UEF) using the RESNET EF Calculator 2017. The calculated EF must meet the efficiency levels specified in the ENERGY STAR Multifamily Reference Design.
72. In accordance with Section 7.4.3 of ASHRAE 90.1-2016, the following in-unit DHW piping requires insulation:
 - a. Recirculating system piping, including the supply and return piping of a circulating tank type water heater.
 - b. The first 8 feet of outlet piping of a constant-temperature nonrecirculating storage system.
 - c. The first 8 feet of branch piping connecting to recirculated, heat-traced, or impedance heated piping.
 - d. The inlet piping between the storage tank and a heat trap in a nonrecirculating storage system.
 - e. Piping that is externally heated (such as heat trace or impedance heating).
73. To measure the delivery temperature, turn the hot water at a fixture completely on and place a digital thermometer in the stream of water. Observe the thermometer and when no additional rise in temperature occurs after 10 seconds, confirm this temperature does not exceed 125°F.



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74. Senior housing projects can use the space-by-space allowances for 'facilities for the visually impaired' in ASHRAE 90.1-2016 Appendix G Table G3.7 for spaces used primarily by building residents. For example, 1.15 W/SF lighting power allowance may be used for the corridors in the baseline. To qualify for the increased allowance, the project must be designed to comply with the light levels in ANSI / IES RP-28 and must provide housing for seniors and/or people with special visual needs. Prescriptive Path dwelling unit overall in-unit lighting power density is permitted to be ≤ 1.3 W/SF, using 1.65 W/SF where lighting is not installed.
75. Lighting power density values from ASHRAE 90.1-2007 Section 9 for Space-by-Space Method for typical common spaces in multifamily properties are shown in the table below. Projects following the Building Area method, the lighting power density is 0.7 W/ft². For spaces not shown, refer to ASHRAE 90.1-2007 Section 9.

ASHRAE Space Type	Lighting Power Densities (W/ft ²)	ASHRAE Space Type	Lighting Power Densities (W/ft ²)	ASHRAE Space Type	Lighting Power Densities (W/ft ²)
Lobby / Elevator	1.3	Corridor / Transition	0.5	Office	1.1
Active Storage (e.g., trash chute / room, janitor closet)	0.8	Stairs - Active	0.6	Lounge / Recreation / Community Room / Computer Room	1.2
Inactive Storage (e.g., tenant storage)	0.3	Restroom	0.9	Electrical / Mechanical	1.5
Exercise Area / Room	0.9	Laundry Room	1.3	Workshop	1.9

76. This requirement applies to exterior lighting fixtures that are attached to the building, but does not apply to landscape or parking lot lighting fixtures.
77. For Prescriptive Path dwelling units, ENERGY STAR certified fixtures or light bulbs are required; however, the Rater is only responsible for verifying that the installed lighting meets the Tier I or Tier II definition specified in ANSI / RESNET / ICC Std. 301. For locations outside the dwelling unit, as an alternative to ENERGY STAR certified fixtures or light bulbs, lighting that meets the Tier I or Tier II definition specified in ANSI / RESNET / ICC Std.301 is permitted.
78. Appliances include refrigerators, dishwashers, clothes washers, and clothes dryers. Where an appliance type is not eligible for ENERGY STAR certification, (e.g., commercial dryers) the appliance is exempt from this requirement. Where a bathroom faucet or aerator is not eligible for WaterSense certification, (e.g., public use lavatory faucets) the fixture is exempt from this requirement.
79. Strategies include: an agreement with the utility companies to provide the aggregated building-level data, in a spreadsheet format or directly through Portfolio Manager; OR evidence that securing signed utility data release forms will be a mandatory component of all lease agreements; OR installation of a building-level energy monitor, data acquisition system, or utility-owned energy meter. If an energy monitor is installed, the builder shall provide the building operator with the manufacturer's documentation and operations manual. EPA recommends, but does not require, that one of these strategies also be implemented in buildings 25,000-49,999 ft².



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Exhibit X – Prescriptive Minimum Heating and Cooling Equipment Efficiencies [†]

Equipment Type	Minimum Efficiency
Room AC (window, through-wall, ductless mini-splits)	ENERGY STAR certified
Air conditioners, air cooled (<13 KBtu/h)	13 SEER
Air conditioners, air cooled (≥13 and <65 KBtu/h)	See Reference Design
Air conditioners, air cooled (≥65 and <240 KBtu/h)	11.5 EER/12.0 IEER
Air conditioners, air cooled (≥240 and < 760 KBtu/h)	10.0 EER/10.5 IEER
Electric resistance space heating	<ul style="list-style-type: none"> Not permitted in any dwelling unit using the Prescriptive Path Electric resistance heating specified in common spaces has a total heating capacity ≤ 12 kBtu/h (3.5 kW) per enclosed space and has automatic thermostatic controls
Warm-Air Furnace (<225 KBtu/h, common spaces)	78% AFUE or 80% Et
Warm-Air Furnace (<225 KBtu/h, dwelling units)	See Reference Design. For PTAC, use 80% Et
Warm-Air Furnace (≥225 KBtu/h)	80% Et (gas) or 81% Et (oil)
Packaged Terminal Air Conditioner (PTAC < 7 kBtu/h)	11.9 EER
Packaged Terminal Air Conditioner (PTAC > 15 kBtu/h)	9.5 EER
Packaged Terminal Air Conditioner (≥7 and ≤15 KBtu/h)	14.0 – (0.300 X Cap/1000) EER
Packaged Terminal Heat Pump (PTHP)	<u>Cooling</u> : 14.0– (0.3 X Cap/1000) EER <u>Heating</u> : 3.7– (0.052 X Cap/1000) COP
Air cooled heat pump (≥13 and <65 KBtu/h)	See Reference Design
Air cooled heat pump (≥65 and <240 KBtu/h)	<u>Cooling</u> : 11.1 EER/11.6 IEER <u>Heating</u> : 3.3 COP (@47°F DB)
Air cooled heat pump (≥240 KBtu/h)	<u>Cooling</u> : 9.6 EER/9.6 IEER <u>Heating</u> : 3.2 COP (@47°F DB)
Water-source heat pump (<135 KBtu/h)	<u>Cooling</u> : 14.0 EER(86°F entering water) <u>Heating</u> : 4.2 COP(68°F entering water)
Boilers, hot water (<300,000 Btu/h)	See Reference Design
Boilers, hot water (≥300,000 Btu/h)	86% E _t (89% E _t if using heat pumps)
VRF Air Conditioners and Heat Pumps	See Tables 6.8.1I and 6.8.1J of ASHRAE 90.1-2010
Air-cooled chillers with or without condenser	10.0 EER / 12.5 IPLV
Water-cooled chiller, positive displacement (<75 tons)	0.780 kW/ton (Full load) / 0.630 kW/ton (IPLV)
Water-cooled chiller, positive displacement (75-150 tons)	0.775 kW/ton (Full load) / 0.615 kW/ton (IPLV)
Water-cooled chiller, positive displacement (150-300tons)	0.680 kW/ton (Full load) / 0.580 kW/ton (IPLV)
Water-cooled chiller, positive displacement (>300 tons)	0.620 kW/ton (Full load) / 0.540 kW/ton (IPLV)
Water-cooled, centrifugal (<300 tons)	0.634 kW/ton (Full load) / 0.596 kW/ton (IPLV)
Water-cooled, centrifugal (≥300 and <600 tons)	0.576 kW/ton (Full load) / 0.549 kW/ton (IPLV)
Water-cooled, centrifugal (≥600 tons)	0.570 kW/ton (Full load) / 0.539 kW/ton (IPLV)
Air-cooled absorption single effect chiller	0.6 COP
Water-cooled absorption single effect chiller	0.7 COP
Absorption double effect indirect-fired chiller	1.0 COP (Full load) / 1.05 COP (IPLV)
Absorption double effect direct-fired chiller	1.0 COP (Full load) / 1.00 COP (IPLV)
Open-loop propeller or axial fan cooling towers [*]	>40 gpm/hp (@95°F entering water, 85°F leaving water, 75°F wb entering air)
Closed-loop propeller or axial fan cooling towers [*]	>15 gpm/hp (@102°F entering water, 90°F leaving water, 75°F wb entering air)
Open-loop centrifugal fan cooling towers [*]	>22 gpm/hp (@95°F entering water, 85°F leaving water, 75°F wb entering air)
Closed-loop centrifugal fan cooling towers [*]	>8 gpm/hp (@102°F entering water, 90°F leaving water, 75°F wb entering air)

Cap means the rated capacity of the product in Btu/h. If < 7,000 Btu/h, use 7,000; if > 15,000, use 15,000 in calculation.

*Cooling tower fan motors must be equipped with VFD controlled by a temperature sensor on the condenser water supply pipe.

[†] For Equipment Types not listed here, minimum efficiencies shall be based on those listed in ASHRAE 90.1-2010.



National HVAC Functional Testing Checklist ¹

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HVAC Functional Testing Agent Responsibilities:

- The entity verifying Functional Testing, the Functional Testing Agent ("FT Agent"), must be a contractor credentialed by an HVAC Quality Installation Training and Oversight organization (H-QUITO), or must hold an approved credential, as listed at www.energystar.gov/ftas, or must be a representative of the Original Equipment Manufacturer (OEM) to complete this checklist. A contractor credentialed by an H-QUITO is only permitted to complete Sections 1-5 of this checklist. ²
- Functional Testing checklists must be completed and signed by an FT Agent. ¹ An FT Agent is permitted to complete just the specific sections of this checklist that pertain to their area of expertise. However, all applicable sections must be completed by an FT Agent, which may result in multiple checklists signed by multiple FT Agents. FT Agents shall only sign checklists that contain items that they have verified. An FT Agent may mark an item as 'verified' by conducting the test or inspection themselves, or witness the test or inspection being conducted by the installing contractor or other HVAC professional. Where a checkbox for "FT Agent Verified" is not provided, FT Agents should fill in all applicable data fields.
- Functional Testing checklists must include all HVAC systems in the building / project that serve the dwelling units, common spaces, and where applicable, parking garages, but may exclude systems solely serving commercial / retail spaces. Multiple checklists will be needed to document all HVAC systems in the building / project. Except where items are verified by the installing contractor, items on the Functional Testing Checklist are permitted to be verified using [MFNC HVAC Functional Testing Checklist Sampling Protocols](#).
- The completed checklists, along with the corresponding National HVAC Design Report, shall be retained by the FT Agent for quality assurance purposes. Furthermore, if the FT Agent is not a credentialed contractor, they shall provide the completed and signed checklists to the builder / developer and the Rater ³ responsible for certifying the units / building, prior to the project's certification. Credentialed contractors shall provide the checklist upon request.

1. Functional Testing Overview

- 1.1 Company performing Functional Testing: _____ FT Agent name: _____ Date: _____
- 1.2 Functional Testing Agent Credential: _____
If a credentialed contractor, fill out applicable H-QUITO and ID Number: ☐ ACCA ☐ Advanced Energy ID Number: _____
- 1.3 Builder / developer client name: _____
- 1.4 Project address: _____ City: _____ State: _____ Zip code: _____
- 1.5 National HVAC Design Report corresponding to this project has been collected from designer or builder. ☐
- 1.6 Checklist applies to the following equipment (include unit # as applicable): _____

2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is $\leq 55^{\circ}\text{F}$ or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. ⁴ This section must be completed for refrigerant-based systems with field-installed refrigerant piping or components (i.e., split air conditioners, air-source heat pumps, and water-source heat pumps), up to 65 kBtu/h, whether serving dwelling units or common spaces in the building. Ducted or non-ducted single-packaged systems (i.e., PTAC), mini-splits, or multi-splits are exempt from this section. When using the alternative OEM test procedure in Item 2.16, check "NA" for Items 2.1-2.15. ⁵

	FT Agent Verified	N/A <input type="checkbox"/>
2.1 Outdoor ambient temperature at condenser: _____ $^{\circ}\text{F}$ DB	-	-
2.2 Return-side air temperature inside duct near evaporator, during cooling mode: _____ $^{\circ}\text{F}$ WB	-	<input type="checkbox"/>
2.3 Liquid line pressure: _____ psig	-	<input type="checkbox"/>
2.4 Liquid line temperature: _____ $^{\circ}\text{F}$ DB	-	<input type="checkbox"/>
2.5 Suction line pressure: _____ psig	-	<input type="checkbox"/>
2.6 Suction line temperature: _____ $^{\circ}\text{F}$ DB	-	<input type="checkbox"/>
For System with Thermal Expansion Valve (TXV):		
2.7 Condenser saturation temperature: _____ $^{\circ}\text{F}$ DB (Using Item 2.3)	-	<input type="checkbox"/>
2.8 Subcooling value: _____ $^{\circ}\text{F}$ DB (Item 2.7 – Item 2.4)	-	<input type="checkbox"/>
2.9 OEM subcooling goal: _____ $^{\circ}\text{F}$ DB	-	<input type="checkbox"/>
2.10 Subcooling deviation: _____ $^{\circ}\text{F}$ DB (Item 2.8 – Item 2.9)	-	<input type="checkbox"/>
For System with Fixed Orifice:		
2.11 Evaporator saturation temperature: _____ $^{\circ}\text{F}$ DB (Using Item 2.5)	-	<input type="checkbox"/>
2.12 Superheat value: _____ $^{\circ}\text{F}$ DB (Item 2.6 – Item 2.11)	-	<input type="checkbox"/>
2.13 OEM superheat goal: _____ $^{\circ}\text{F}$ DB (Using superheat tables and Items 2.1 & 2.2)	-	<input type="checkbox"/>
2.14 Superheat deviation: _____ $^{\circ}\text{F}$ DB (Item 2.12 – Item 2.13)	-	<input type="checkbox"/>
2.15 Item 2.10 is $\pm 3^{\circ}\text{F}$ or Item 2.14 is $\pm 5^{\circ}\text{F}$.	<input type="checkbox"/>	<input type="checkbox"/>
2.16 An OEM test procedure (e.g., as defined for a ground-source heat pump) has been used in place of the sub-cooling or super-heat process and documentation has been attached that defines this procedure.	<input type="checkbox"/>	<input type="checkbox"/>



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3. Indoor HVAC Fan Airflow - This section must be completed for split air conditioners, unitary air conditioners, air-source heat pumps (including multi-splits), and water-source (i.e., geothermal or water-loop) heat pumps up to 65 kBtuh with forced-air distribution systems (i.e., ducts) and to furnaces up to 225 kBtuh with forced-air distribution systems (i.e., ducts), whether serving dwelling units or other common spaces in the building. Mini-splits, ducted or non-ducted, are exempt; however, multi-split systems such as shared VRF systems, where indoor HVAC fans with forced-air distribution are connected to a shared outdoor unit that exceeds 65 kBtuh, are not exempt. ⁵		FT Agent Verified	N/A
3.1 The mode with the higher design HVAC fan airflow used, per Item 5.2 of National HVAC Design Report: <input type="checkbox"/> Heating <input type="checkbox"/> Cooling	<input type="checkbox"/>	-	
3.2 Static pressure test holes have been created, and test hole locations are well-marked and accessible.	<input type="checkbox"/>	-	
Test hole location for return external static pressure: <input type="checkbox"/> Plenum <input type="checkbox"/> Cabinet <input type="checkbox"/> Transition <input type="checkbox"/> Other: _____	-	-	
Test hole location for supply external static pressure: <input type="checkbox"/> Plenum <input type="checkbox"/> Cabinet <input type="checkbox"/> Transition <input type="checkbox"/> Other: _____	-	-	
3.3 Measured return external static pressure (Enter value only, without negative sign): _____ IWC	-	-	
3.4 Measured supply external static pressure (Enter value only, without positive sign): _____ IWC	-	-	
3.5 Measured total external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 = _____ IWC	-	-	
3.6 Measured (Item 3.5) - Design (Item 5.2 on National HVAC Design Report) total external static pressure = _____ IWC	-	-	
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: _____ CFM	-	-	
3.8 Measured HVAC fan airflow (Item 3.7) is \pm 15% of design HVAC fan airflow (Item 5.2 on National HVAC Design Report).	<input type="checkbox"/>	-	
4. Air Balancing of Supply Registers & Return Grilles (Recommended, but not Required) ⁶	Rater Verified	FT Agent Verified	N/A
4.1 Balancing report attached with room-by-room design airflows from Item 5.2 on National HVAC Design Report, and contractor-measured airflow using ANSI / ACCA 5 QI-2015 protocol.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 Room-by-room airflows verified to be within the greater of \pm 20% or 25 CFM of design airflow.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Functional Testing: Indoor / Terminal Units - This section must be completed for all heating and cooling equipment located within dwelling units or common spaces, including systems identified in Sections 2 and 3, except where specifically noted. Indoor / terminal units include, but are not limited to, mini-splits, multi-splits, PTAC's, PTHP's, WLHP's, fan coils, and hydronic distribution systems. ⁵	Rater Verified	FT Agent Verified	N/A
5.1 Installation Checks			
5.1.1 Zone thermostat (or remote zone temperature sensor) in dwelling units installed in design location, within the zone being served, and not on an exterior wall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2 Functional Testing			
5.2.1 Measured zone temperature is within 5°F of zone temperature displayed on thermostat or sensor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2.2 System turns on when there is a call for heat and heating is provided. System turns off when the heating setpoint has been met. ⁷ N/A due to ambient temperature _____ °F or equipment lock-out <input type="checkbox"/> For forced air systems: Measured discharge air temperature _____ °F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2.3 System turns on when there is a call for cooling and cooling is provided. System turns off when the cooling setpoint has been met. ⁷ N/A due to ambient temperature _____ °F or equipment lock-out <input type="checkbox"/> For forced air systems: Measured discharge air temperature _____ °F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2.4 Where OA dampers are installed, the damper closes when there is no call for ventilation or when fan is off.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2.5 If more than one system provides heating or cooling to the same space, controls prevent simultaneous heating and cooling.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Shared VRF Outdoor Units - This section must be completed for commercial-grade VRF outdoor units serving multiple dwelling units or common spaces.	FT Agent Verified	N/A	
6.1 Installation Checks			
6.1.1 Pressure testing on refrigerant piping has been completed for this system. (indicate exact test in / test out pressure (psig) / time (hours)): _____ / _____ / _____	-	<input type="checkbox"/>	
6.1.2 Vacuum testing has been completed. (indicate exact test in / test out pressure (psig) / time (hours)): _____ / _____ / _____	-	<input type="checkbox"/>	
6.1.3 Refrigerant line lengths and height differences have been recorded from as-built shop drawings or field measured, and documentation of the measurement is available, if requested.	<input type="checkbox"/>	<input type="checkbox"/>	
6.1.4 Indicate required additional charge amount (lbs): _____	-	<input type="checkbox"/>	



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6.2 Functional Testing		
6.2.1 In cooling mode, the outdoor unit fan is ON and heat is being rejected. ^{7,9} Measure and verify that outdoor unit fan discharge air temperature is warmer than the ambient air temperature. N/A due to ambient temperature ____ °F or equipment lock-out <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2.2 In heating mode, the outdoor unit fan is ON and heat is being absorbed. ^{7,9} Measure and verify that outdoor unit fan discharge air temperature is colder than the ambient air temperature. N/A due to ambient temperature ____ °F or equipment lock-out <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2.3 Using the central maintenance tool or controller, none of the outdoor units or connected indoor units are showing an alarm.	<input type="checkbox"/>	<input type="checkbox"/>
6.2.4 Using the central maintenance tool, the manufacturer's representative confirmed refrigerant charge test per manufacturer's guidelines.	<input type="checkbox"/>	<input type="checkbox"/>
7. Boilers - This section must be completed for all commercial-grade space heating boilers serving multiple dwelling units.	FT Agent Verified	N/A
7.1 Installation Checks		
7.1.1 Piping pressure testing is completed, and all accessible boiler piping, fittings, and accessories are free from leaks.	<input type="checkbox"/>	<input type="checkbox"/>
7.1.2 Boiler relief valves and discharge piping do not show signs of weeping or leakage.	<input type="checkbox"/>	<input type="checkbox"/>
7.1.3 No signs of blockage, leakage, or deterioration in the fresh air intake or flue gas vent piping.	<input type="checkbox"/>	<input type="checkbox"/>
7.1.4 Temperature, pressure gauges, air eliminator, expansion tank, check valves and all other piping components installed as specified by HVAC Designer.	<input type="checkbox"/>	<input type="checkbox"/>
7.1.5 Boiler supply / header temperature sensor and, where applicable, outdoor air temperature sensor, are located as specified by HVAC Designer.	<input type="checkbox"/>	<input type="checkbox"/>
7.1.6 Indicate boiler header / supply setpoint type: <input type="checkbox"/> Fixed <input type="checkbox"/> Seasonal <input type="checkbox"/> Outdoor temperature reset <input type="checkbox"/> Indoor temperature reset <input type="checkbox"/> Other: _____	-	<input type="checkbox"/>
7.1.7 Where outdoor air temperature reset schedule is applicable, indicate reset schedule. (e.g., 180°F Supply @ 10°F outdoor, 120°F supply @ 55°F outdoor.) _____ @ _____, _____ @ _____	-	<input type="checkbox"/>
7.1.8 Where Warm Weather Shut Down (WWSD) is applicable, list temperature. (NA if boilers and system pumps also serve DHW.)	____ °F	<input type="checkbox"/>
7.2 Functional Testing: Boilers ⁷ - N/A due to ambient temperature ____ °F or equipment lock-out <input type="checkbox"/>		
7.2.1 Measure the combustion gas efficiency at high fire and low fire for one of the boilers. Note which one and record information. ⁷ _____% <input type="checkbox"/> high fire _____% <input type="checkbox"/> low fire	-	<input type="checkbox"/>
7.2.2 Where not direct-vented, boiler combustion air intake dampers open / close with boiler operation. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
7.2.3 If each boiler has its own dedicated boiler circulator pump, it operates only when the respective boiler is firing. ⁷ (Circulator pump may run for a short period of time before or after the boiler fires, as recommended by the equipment manufacturer.)	<input type="checkbox"/>	<input type="checkbox"/>
7.2.4 When there is a call for heating, the boiler(s) are enabled according to their design sequence of operation. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
7.2.5 When multiple boilers are supposed to operate at the same time, they operate according to the Engineer of Record's sequence of operation and the on / off sequencing is observed. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
7.2.6 Cycle the boilers on and off 1 time. Boiler(s) modulate / step down to the minimum firing rate before shutting off. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
7.2.7 Boiler(s) do not short cycle (i.e., the minimum on time is 5 minutes and the minimum off time is 5 minutes, or as recommended by the boiler manufacturer to prevent short cycling). ⁷	<input type="checkbox"/>	<input type="checkbox"/>
7.2.8 Condensing Boiler: Return temperature enables condensing. ⁷ Design / OEM temp: ____ °F Measured temp: ____ °F	<input type="checkbox"/>	<input type="checkbox"/>
7.2.9 Boiler supply / header temperature sensor is reading within 3°F of measured boiler supply / header temperature. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
7.2.10 Boiler minimum flow rate and change in flow rate are maintained within the manufacturer's stated limits throughout the sequence of operation. ^{7,8}	<input type="checkbox"/>	<input type="checkbox"/>
7.3 Functional Testing: Heating System Pumps		
7.3.1 Where heating system pumps (i.e., the pumps which are responsible for moving the water through the terminal units) are equipped with a VFD which is responding to a pressure sensor within the system or a sensorless pumping system, indicate which one: <input type="checkbox"/> VFD+Sensor <input type="checkbox"/> Sensorless	-	<input type="checkbox"/>
7.3.2 If a variable speed pumping system is installed, the VFD increases and decreases pump speed in response to changes in the system.	<input type="checkbox"/>	<input type="checkbox"/>
7.3.3 If a variable speed pumping system is installed, system prevents "dead-heading". (May be tested under real or simulated low flow conditions.) Select the method of water flow bypass: <input type="checkbox"/> Minimum Flow Bypass Valve <input type="checkbox"/> 3 way valves on specific terminal units <input type="checkbox"/> Other: _____	<input type="checkbox"/>	<input type="checkbox"/>
7.3.4 Pumps are off when outside air temperature is above WWSD. (N/A if pumps serve DHW as well as heating.)	<input type="checkbox"/>	<input type="checkbox"/>



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8. Cooling Towers - This section must be completed for all cooling towers serving dwelling units or common spaces.	FT Agent Verified	N/A
8.1 Installation Checks		
8.1.1 Cooling Tower piping and all components are free from leaks.	<input type="checkbox"/>	<input type="checkbox"/>
8.1.2 Temperature gauges, check valves, tower bypass valve and all other piping components installed as specified by HVAC Designer.	<input type="checkbox"/>	<input type="checkbox"/>
8.1.3 Condenser Water Supply setpoint type: <input type="checkbox"/> Fixed <input type="checkbox"/> Outdoor temperature reset <input type="checkbox"/> Seasonal / based on free cooling	-	<input type="checkbox"/>
8.1.4 All control sensors (condenser water supply temperature, outdoor air humidity, etc.) are located as specified by HVAC Designer.	<input type="checkbox"/>	<input type="checkbox"/>
8.2 Functional Testing: Tower Fans ⁷ - N/A due to ambient temperature ____ °F or equipment lock-out <input type="checkbox"/>		<input type="checkbox"/>
8.2.1 Tower fan(s) do not short cycle (i.e., the minimum on time is 5 minutes and the minimum off time is 5 minutes, or as recommended by the manufacturer to prevent short cycling). ⁷	<input type="checkbox"/>	<input type="checkbox"/>
8.2.2 Cooling Tower fan(s) do not run unless associated cooling tower pump(s) are running. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
8.2.3 If installed, basin heater is not enabled when the basin water temperature is above the setpoint. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
8.2.4 Condenser Water Supply Sensor is reading within 3°F of measured temperature. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
8.3 Functional Testing: Cooling Tower Pumps		
8.3.1 Cycle the cooling tower pumps on and off 1 time. Cooling tower pumps only operate when controls call for operation. (N/A if tower pumps are set to run year round.) ⁷	<input type="checkbox"/>	<input type="checkbox"/>
9. Chillers - This section must be completed for all chillers serving dwelling units or common spaces.		
9.1 Installation Checks		
9.1.1 Chiller piping and all components are free from leaks.	<input type="checkbox"/>	<input type="checkbox"/>
9.1.2 If multiple chillers, water flow is balanced across chillers using (indicate which one): <input type="checkbox"/> Balancing valves <input type="checkbox"/> Reverse return piping <input type="checkbox"/> Individual chiller pumps <input type="checkbox"/> Other: _____	-	<input type="checkbox"/>
9.1.3 Temperature, pressure gauges, air eliminator, expansion tank, check valves and all other piping components installed as specified by HVAC Designer.	<input type="checkbox"/>	<input type="checkbox"/>
9.1.4 Chilled Water Supply temperature sensor (and outdoor air temperature sensor where applicable) are located as specified by HVAC Designer.	<input type="checkbox"/>	<input type="checkbox"/>
9.2 Functional Testing: Chillers ⁷ - N/A due to ambient temperature ____ °F or equipment lock-out <input type="checkbox"/>		<input type="checkbox"/>
9.2.1 When there is a call for cooling, chillers are operating and maintaining chilled water setpoint. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
9.2.2 When multiple chillers are supposed to operate at the same time, they operate according to the Engineer of Record's sequence of operations and the on / off sequencing is observed. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
9.2.3 Chiller(s) do not short cycle (i.e., the minimum on time is 5 minutes and the minimum off time is 5 minutes, or as recommended by the chiller manufacturer to prevent short cycling). ⁷	<input type="checkbox"/>	<input type="checkbox"/>
9.2.4 Chilled Water Supply Sensor is reading within 3°F of measured chiller temperature. ⁷	<input type="checkbox"/>	<input type="checkbox"/>
9.2.5 Chiller minimum flow rate and change in flow rate are maintained within the manufacturer's stated limits throughout the sequence of operation. ^{7, 8}	<input type="checkbox"/>	<input type="checkbox"/>
9.3 Functional Testing: Chilled Water System Pumps		
9.3.1 Where Chilled Water System pumps (i.e., the pumps which are responsible for moving the chilled water through the terminal units) are equipped with a VFD, which is responding to a pressure sensor within the system or a sensorless VFD system, indicate which one: <input type="checkbox"/> VFD+Sensor <input type="checkbox"/> Sensorless	-	<input type="checkbox"/>
9.3.2 If a variable speed pumping system is installed, confirm that the VFD increases and decreases pump speed in response to changes in the system.	<input type="checkbox"/>	<input type="checkbox"/>
9.3.3 If a variable speed pumping system is installed, system prevents "dead-heading". (May be tested under real or simulated low flow conditions.) Select the method of water flow bypass: <input type="checkbox"/> Minimum Flow Bypass Valve <input type="checkbox"/> 3 way valves on specific terminal units <input type="checkbox"/> Other: _____	<input type="checkbox"/>	<input type="checkbox"/>
9.3.4 Pumps are off when cooling is not required. (N/A if chilled water is required year round.)	<input type="checkbox"/>	<input type="checkbox"/>
FT Agent Name: _____ Date: _____		
FT Agent Signature: _____ Company Name: _____		
Rater Name (if applicable): _____ Date: _____		
Rater Signature: _____ Company Name: _____		



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Footnotes:

1. This Checklist is designed to align with the requirements of ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new multifamily buildings when compared to new multifamily buildings built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems (e.g., those caused by a lack of maintenance or occupant behavior). Therefore, this Checklist is not a guarantee of proper ventilation, indoor air quality, or HVAC performance.

The checklist may be completed and signed by a Rater, rather than a Functional Testing Agent, if only Sections 1, 4 and 5 are applicable. A Rater completing Section 5 or Item 4.2 for a system that is also being verified by a Functional Testing Agent, may sign the same checklist as the FT Agent. For units following Track A, a Functional Testing Agent is not needed to complete Sections 2 and 3 for unitary HVAC systems serving dwelling units that will be verified and graded by the Rater. Track A – Dwelling Unit HVAC Grading shall not be used until an implementation schedule has been defined for ANSI / RESNET / ACCA Std. 310 by the Home Certification Organization (HCO) or Multifamily Review Organization (MRO) that the building is being certified under. Track A – Dwelling Unit HVAC Grading shall then use ANSI / RESNET / ACCA Std. 310 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO or MRO that the building is being certified under.

Sections 2, 3, and 4 of this Checklist generally apply to split air conditioners, unitary air conditioners, air-source heat pumps, and water-source (i.e., geothermal or water-loop) heat pumps up to 65 kBtuh with forced-air distribution systems (i.e., ducts) and to furnaces up to 225 kBtuh with forced-air distribution systems (i.e., ducts). See specific sections for exemptions. If exempted, a Rater may complete those sections as N/A.

Where the term 'dwelling unit' is used in this Checklist, the requirement is also required of 'sleeping' units. The term 'sleeping unit' refers to a room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both.

The term 'common space' refers to any spaces in the building being certified that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, and dining halls, as well as offices or other spaces used by building management, administration or maintenance in support of the residents.
2. An explanation of the credentialing process and links to H-QUITOs, which maintain lists of credentialed contractors, can be found at www.energystar.gov/findhvac. FT Agents may not be the installing contractor, nor employed by the same company as the installing contractor, unless they are a credentialed contractor. All FT Agents that are not credentialed contractors must sign up online in EPA's online database as an FT Agent and watch the online FT Agent orientation. See www.energystar.gov/ftas.
3. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater, Approved Inspector, as defined by ANSI / RESNET / IECC Standard 301, or an equivalent designation as determined by an HCO or MRO; and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/mftraining.
4. Either factory-installed or field-installed TXV's may be used. For field-installed TXV's, ensure that sensing bulbs are insulated and tightly clamped to the vapor line with good linear thermal contact at the recommended orientation, usually 4 or 8 o'clock.
5. The term "mini-split" refers to air conditioners and heat pumps that have variable refrigerant flow and distributed refrigerant technology with a single outdoor section serving a single indoor section. The indoor section is typically, but not exclusively, mounted on room walls and/or ceilings and designed to heat or cool air within the conditioned space either directly or through limited duct runs. The term "multi-split" refers to air conditioners and heat pumps that have variable refrigerant flow and distributed refrigerant technology with the capability of serving multiple indoor sections with a single outdoor section. The indoor sections are typically, but not exclusively, mounted on room walls and/or ceilings and designed to heat or cool air within the conditioned space either directly or through a ducted system. A single outdoor section can serve one or more dwelling units. The length of the duct system is not a determinant for meeting either of these definitions. Systems where total supply duct length of the entire system, including the sum of all supply trunks and branches, is 10 ft or less, may complete Item 4.2 in lieu of Section 3.
6. Air balancing of supply registers and return grilles is highly recommended to improve the performance of the HVAC system and comfort of the occupants, but is not required at this time for certification. When air balancing is completed, balancing dampers or proper duct sizing shall be used instead of looped or coiled ductwork to limit flow to diffusers. When balancing dampers are used, they shall be located at the trunk to limit noise unless the trunk will not be accessible when the balancing process is conducted. In such cases, Opposable Blade Dampers (OBD) or dampers located in the duct boot are permitted to be used.
7. For seasonally dependent testing: Where temperature lock-outs or equipment safety lock-outs prevent systems from operating in the specified mode during functional testing, "N/A" may be checked. The builder or developer must then provide signed documentation acknowledging that components of the Functional Testing were not completed due to temperature lock-outs or equipment safety lock-outs.
8. This test can be marked "Verified" if the boiler or chiller does not shut off on low water or high temperature during sequence testing. Direct water flow measurements can be taken throughout testing but are not required.
9. When manually testing outdoor unit heating or cooling mode of operation, at least 25% of associated indoor / terminal units connected to the outdoor unit(s) shall be controlled to the same heating or cooling mode being tested. The FT Agent shall increase the number of indoor / terminal units as needed in order to verify the discharge temperature is warmer / colder than ambient.



National Water Management System Requirements ¹

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Builder / Developer Partner Responsibilities:

- It is the exclusive responsibility of the Partner to ensure that each multifamily building is constructed to meet these requirements.
- While Partners are not required to maintain documentation demonstrating compliance for each multifamily building, Partners are required to develop a process to ensure compliance for each building (e.g., incorporate these requirements into the Scope of Work for relevant sub-contractors, require the site supervisor to inspect each building for these requirements, and/or sub-contract the verification of these requirements to a Rater ²).
- In the event that the EPA determines that a certified multifamily building was constructed without meeting these requirements, the building may be decertified.

1. Water-Managed Site and Foundation

- 1.1 Impermeable surfaces, such as patio, porch, or plaza slabs, sidewalks, ramps and driveways, sloped ≥ 0.25 in. per ft. away from building to edge of surface or 10 ft., whichever is less. ³
- 1.2 Back-fill has been tamped, and permeable surfaces sloped ≥ 0.5 in. per ft. away from building for ≥ 10 ft. Alternatives in Footnote. ³
- 1.3 Capillary break beneath all slabs (e.g., slab on grade, basement slab) except crawlspace slabs using either: ≥ 6 mil polyethylene sheeting, lapped 6-12 in., or ≥ 1 in. extruded polystyrene insulation with taped joints. See additional exemptions for garage slabs in Footnote 4. ^{4, 5, 6, 7}
- 1.4 Capillary break at all crawlspace floors using ≥ 6 mil polyethylene sheeting, lapped 6-12 in., & installed using one of the following: ^{5, 6, 7}
 - 1.4.1 Placed beneath a concrete slab; OR,
 - 1.4.2 Lapped up each wall or pier and fastened with furring strips or equivalent; OR,
 - 1.4.3 Secured in the ground at the perimeter using stakes.
- 1.5 Exterior surface of below-grade walls of basements & unvented crawlspaces finished as follows:
 - a) For poured concrete, masonry, & insulated concrete forms, finish with damp-proofing coating. ⁸
 - b) For wood framed walls, finish with polyethylene and adhesive or other equivalent waterproofing.
- 1.6 Class 1 vapor retarder not installed on interior side of air permeable insulation in exterior below-grade walls. ⁹
- 1.7 Sump pit cover mechanically attached with full gasket seal or equivalent.
- 1.8 Drain tile installed at basement and crawlspace walls, with the top of the drain tile pipe below the bottom of the concrete slab or crawlspace floor. Drain tile surrounded with ≥ 6 in. of $\frac{1}{2}$ to $\frac{3}{4}$ in. washed or clean gravel and with gravel layer fully wrapped with fabric cloth. Drain tile level or sloped to discharge to outside grade (daylight) or to a sump pit with a pump. If drain tile is on interior side of footing, then channel provided through footing to exterior side. ¹⁰

2. Water-Managed Wall Assembly

- 2.1 Flashing at bottom of exterior walls with weep holes included for masonry veneer and weep screed for stucco cladding systems, or equivalent drainage system. ¹¹
- 2.2 Fully sealed continuous drainage plane behind exterior cladding that laps over flashing in Item 2.1 and fully sealed at all penetrations. Additional bond-break drainage plane layer provided behind all stucco and non-structural masonry cladding wall assemblies. ^{11, 12}
- 2.3 Window and door openings fully flashed. ¹³

3. Water-Managed Roof Assembly

- 3.1 Step and kick-out flashing at all roof-wall intersections, extending ≥ 4 " on wall surface above roof deck and integrated shingle-style with drainage plane above; boot / collar flashing at all roof penetrations. ¹⁴
- 3.2 For buildings that don't have a slab-on-grade foundation and do have expansive or collapsible soils, gutters & downspouts provided that empty to lateral piping that discharges water on sloping final grade ≥ 5 ft. from foundation, or to underground catchment system not connected to the foundation drain system that discharges water ≥ 10 ft. from foundation. Alternatives & exemptions in Footnote. ^{5, 15, 16}
- 3.3 Self-adhering polymer-modified bituminous membrane at all valleys & roof deck penetrations. ^{5, 17}
- 3.4 In 2009 IECC Climate Zones 5 & higher, self-adhering polymer-modified bituminous membrane over sheathing at eaves from the edge of the roof line to > 2 ft. up roof deck from the interior plane of the exterior wall. ^{5, 17}

4. Water-Managed Building Materials

- 4.1 Wall-to-wall carpet *not* installed within 2.5 ft. of toilets, tubs, and showers.
- 4.2 Cement board or equivalent moisture-resistant backing material installed on all walls behind tub and shower enclosures composed of tile or panel assemblies with caulked joints. Paper-faced backerboard shall not be used. ¹⁸
- 4.3 In Warm-Humid climates, Class 1 vapor retarders not installed on the interior side of air permeable insulation in above-grade walls, except at shower and tub walls. ⁹
- 4.4 Building materials with visible signs of water damage or mold *not* installed or allowed to remain. ¹⁹
- 4.5 Framing members & insulation products having high moisture content *not* enclosed (e.g., with drywall). ²⁰
- 4.6 For each condensate-producing HVAC component, corrosion-resistant drain pan (e.g., galvanized steel, plastic) included that drains to a conspicuous point of disposal in case of blockage. Backflow prevention valve included if connected to a shared drainage system.



National Water Management System Requirements¹

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Footnotes:

1. These requirements are designed to improve moisture control in buildings. However, these features alone cannot prevent all moisture problems. For example, leaky pipes or overflowing baths can lead to moisture issues and negatively impact the performance of the building. For the purpose of this document, the term 'Partner' represents either the builder or the developer.
2. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater, Approved Inspector, or an equivalent designation as determined by a Verification Oversight Organization or Multifamily Review Organization and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/mftraining.
3. Swales or drains designed to carry water from foundation are permitted to be provided as an alternative to the slope requirements for any building, and shall be provided for a building where setbacks limit space to less than 10 ft. Also, tamping of back-fill is not required if either: proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer; OR, the builder / developer has scheduled a site visit to provide in-fill and final grading after settling has occurred (e.g., after the first rainy season).
4. Not required for garage slabs that meet any of the following criteria:
 - a. "Open" (i.e., 20% of wall area is openings for natural ventilation); OR
 - b. Mechanically ventilated automatically by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors at a standby airflow rate of not less than 0.05 cfm/ft² and full-on rate not less than 0.75 cfm/ft².
5. Not required in Dry (B) climates as shown in 2009 IECC Figure 301.1 and Table 301.1.
6. Not required for raised pier foundations with no walls. To earn the ENERGY STAR, EPA recommends, but does not require, that radon resistant features be included in buildings built in EPA Radon Zones 1, 2 & 3. For more information, see www.epa.gov/indoorairplus.
7. For an existing slab (e.g., in a building undergoing a gut rehabilitation), in lieu of a capillary break beneath the slab, a continuous and sealed Class I or Class II Vapor Retarder (per Footnote 8) is permitted to be installed on top of the entire slab. In such cases, up to 10% of the slab surface is permitted to be exempted from this requirement (e.g., for sill plates). In addition, for existing slabs in occupiable space, the Vapor Retarder shall be, or shall be protected by, a durable floor surface. If Class I Vapor Retarders are installed, they shall not be installed on the interior side of air permeable insulation or materials prone to moisture damage.
8. Interior surface of an existing below-grade wall (e.g., in a building undergoing a gut rehab.) listed in Item 1.5a is permitted to be finished by:
 - Installing a continuous and sealed drainage plane, capillary break, Class I Vapor Retarder (per Footnote 8) and air barrier that terminates into a foundation drainage system as specified in Item 1.8; OR
 - If a drain tile is not required as specified in Footnote 9, adhering a capillary break and Class I Vapor Retarder (per Footnote 8) directly to the wall with the edges taped / sealed to make it continuous.

Note that no alternative compliance option is provided for existing below-grade wood-framed walls in Item 1.5b.
9. The 2009 IRC defines Class I vapor retarders as a material or assembly with a rating of ≤ 0.1 perm, using the desiccant method with Proc. A of ASTM E 96. The following materials are typically ≤ 0.1 perm and shall not be used on the interior side of air permeable insulation in above-grade exterior walls in warm-humid climates or below-grade exterior walls in any climate: rubber membranes, polyethylene film, glass, aluminum foil, sheet metal, and foil-faced insulating / non-insulating sheathings. These materials can be used on the interior side of walls if air permeable insulation is not present (e.g., foil-faced rigid foam board adjacent to a below-grade concrete foundation wall is permitted).
- Note that this list is not comprehensive and other materials with a perm rating ≤ 0.1 also shall not be used. Also, if mfr. spec.'s for a product indicate a perm rating ≥ 0.1 , then it may be used, even if it is in this list. Also note that open-cell and closed-cell foam generally have ratings above this limit and may be used unless mfr. spec.'s indicate a perm rating ≤ 0.1 . Several exemptions to these requirements apply:

 - Class I vapor retarders, such as ceramic tile, may be used at shower and tub walls;
 - Class I vapor retarders, such as mirrors, may be used if mounted with clips or other spacers that allow air to circulate behind them.
10. Alternatively, either a drain tile that is pre-wrapped with a fabric filter or a Composite Foundation Drainage System (CFDS) that has been evaluated by ICC-ES per AC 243 are permitted to be used. Note that the CFDS must include a soil strip drain or another ICC-ES evaluated perimeter drainage system to be eligible for use. In an existing building (e.g., in a building undergoing a gut rehab.) a drain tile installed only on the interior side of the footing without a channel is permitted. Additionally, a drain tile is not required when a certified hydrologist, soil scientist, or engineer has determined that a crawlspace foundation, or an existing basement foundation (e.g., in a building undergoing a gut rehab.), is installed in Group I Soils (i.e., well-drained ground or sand-gravel mixtures), as defined by 2009 IRC Table R405.1.
11. These Items not required for existing structural masonry walls (e.g., in a building undergoing a gut rehabilitation). Note this exemption does not extend to existing wall assemblies with masonry veneers.
12. Any of the following systems may be used: a monolithic weather-resistant barrier (i.e., house wrap) shingled at horizontal joints and sealed or taped at all joints; weather resistant sheathings (e.g., faced rigid insulation) fully taped at all "butt" joints; lapped shingle-style building paper or felts; or other water-resistive barrier recognized by ICC-ES or other accredited agency.
13. Apply pan flashing over the rough sill framing, inclusive of the corners of the sill framing; side flashing that extends over pan flashing; and top flashing that extends over side flashing or equivalent details for structural masonry walls or structural concrete walls.
14. Intersecting wall siding shall terminate 1 in. above the roof or higher, per manufacturer's recommendations. Continuous flashing shall be installed in place of step flashing for metal and rubber membrane roofs.
15. The assessment of whether the soil is expansive or collapsible shall be completed by a certified hydrologist, soil scientist, or engineer.
16. Any of the following are permitted to be used as alternatives to Item 3.2: a) a roof design that deposits rainwater to a grade-level rock bed with a waterproof liner and a lateral drain pipe that meets discharge requirements per Item 3.2; b) a rainwater harvesting system that drains overflow to meet discharge requirements per Item 3.2; or c) a continuous rubber membrane (e.g., EPDM) that is aligned with the foundation wall from final grade to ≥ 8 in. below grade and then slopes ≥ 0.5 in. per ft. away from the building for at least 5 ft., with Group I Soils (as defined in Footnote 9) covering the membrane to within 3 in. of final grade.



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17. As an alternative, any applicable option in 2009 IRC Section R905.2.8.2 is permitted to be used to meet Item 3.3 and any option in 2009 IRC Section R905.2.7.1 is permitted to be used to meet Item 3.4. EPA recommends, but does not require, that products meet ASTM D1970. In addition, any option in 2009 IRC Section R905.13 is permitted to be used to meet either Item 3.3 or 3.4.
18. In addition to cement board, materials that have been evaluated by ICC-ES per AC 115 may also be used to meet this requirement. Monolithic tub and shower enclosures (e.g., fiberglass with no seams) are exempt from this backing material requirement unless required by the manufacturer. Paper-faced backerboard may only be used behind monolithic enclosures or waterproof membranes that have been evaluated by ICC-ES per AC 115, and then only if it meets ASTM mold-resistant standards ASTM D3273 or ASTM D6329.
19. If mold is present, effort should be made to remove all visible signs of mold (e.g., by damp wipe with water and detergent). If removal methods are not effective, then the material shall be replaced. However, stains that remain after damp wipe are acceptable. Lumber with "sap stain fungi" is exempt from this Item as long as the lumber is structurally intact.
20. For wet-applied insulation, follow manufacturer's drying recommendations. EPA recommends that lumber moisture content be $\leq 18\%$.

SECTION 01 91 00**GENERAL COMMISSIONING REQUIREMENTS****PART 1 - GENERAL****1.1 COMMISSIONING DESCRIPTION**

- A. This Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.
- B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 22 and Division 23 sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.
- C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the Commissioning Agent to be indexed for future reference.
- D. Where training or educational services are required and specified in other sections of the specifications, including but not limited to Division 22 and Division 23 sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.
- E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:
 - 1. Verify that the applicable equipment and systems are installed in accordance with the contract documents and according to the manufacturer's recommendations.
 - 2. Verify and document proper integrated performance of equipment and systems.
 - 3. Verify that Operations & Maintenance documentation is complete.
 - 4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.

5. Verify that the operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
6. Document the successful achievement of the commissioning objectives listed above.
- F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 CONTRACTUAL RELATIONSHIPS

- A. The contracts are administered by the engineer as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer.
- B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to the Engineer and the Contractor.
- C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.
- D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and Resident Engineer. Thus, the procedures outlined in this specification must be executed within the following limitations:
 1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Contractor.
 2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
 3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.
 4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.

5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident Engineer, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.3 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.
- C. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.4 SUMMARY

- A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
- B. The commissioning activities have been developed to support the requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. The commissioning activities have been developed to support the Green Buildings Initiative's Green Globes rating program and to support delivery of project performance in accordance with the requirements developed for the project.

1.5 ACRONYMS

List of Acronyms	
Acronym	Meaning
A/E	Architect / Engineer Design Team
AHJ	Authority Having Jurisdiction
ASHRAE	Association Society for Heating Air Condition and Refrigeration Engineers
BOD	Basis of Design
BSC	Building Systems Commissioning
CCTV	Closed Circuit Television
CD	Construction Documents
CMMS	Computerized Maintenance Management System
CO	Contracting Officer
COR	Contracting Officer's Representative
COBie	Construction Operations Building Information Exchange
CPC	Construction Phase Commissioning
Cx	Commissioning
CxA	Commissioning Agent
CxM	Commissioning Manager
CxR	Commissioning Representative

List of Acronyms	
Acronym	Meaning
DPC	Design Phase Commissioning
FPT	Functional Performance Test
GBI-GG	Green Building Initiative - Green Globes
HVAC	Heating, Ventilation, and Air Conditioning
LEED	Leadership in Energy and Environmental Design
NEBB	National Environmental Balancing Bureau
O&M	Operations & Maintenance
OPR	Owner's Project Requirements
PFC	Pre-Functional Checklist
PFT	Pre-Functional Test
SD	Schematic Design
SO	Site Observation
TAB	Test Adjust and Balance
USGBC	United States Green Building Council

1.6 DEFINITIONS

Acceptance Phase Commissioning: Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

Accuracy: The capability of an instrument to indicate the true value of a measured quantity.

Back Check: A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review

Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

Benchmarks: Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

Building Information Modeling (BIM): Building Information Modeling is a parametric database which allows a building to be designed and constructed virtually in 3D, and provides reports both

in 2D views and as schedules. This electronic information can be extracted and reused for pre-populating facility management CMMS systems. Building Systems Commissioning (BSC): NEBB acronym used to designate its commissioning program.

Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

CCTV: Closed circuit Television. Normally used for security surveillance and alarm detections as part of a special electrical security system.

COBie: Construction Operations Building Information Exchange (COBie) is an electronic industry data format used to transfer information developed during design, construction, and commissioning into the Computer Maintenance Management Systems (CMMS) used to operate facilities. See the Whole Building Design Guide website for further information (<http://www.wbdg.org/resources/cobie.php>)

Commissionability: Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated and commissioned

Commissioning Agent (CxA): The qualified Commissioning Professional who administers the Cx process by managing the Cx team and overseeing the Commissioning Process. Where CxA is used in this specification it means the Commissioning Agent, members of his staff or appointed members of the commissioning team.

Commissioning Checklists: Lists of data or inspections to be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements (OPR) is being achieved.

Commissioning Design Review: The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner's project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems' sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components. (See also – Commissioning Observation).

Commissioning Manager (CxM): A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.

Commissioning Observation: An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

Commissioning Plan: A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

Commissioning Process: A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

Commissioning Report: The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.

Commissioning Specifications: The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Contract Documents (CD): Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

Construction Phase Commissioning (CPC): All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Coordination Drawings: Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

Data Logging: The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

Deferred System Test: Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

Deficiency: See “Commissioning Issue”.

Design Criteria: A listing of the Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

Design Intent: The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

Design Narrative: A written description of the proposed design solutions that satisfy the requirements of the OPR.

Design Phase Commissioning (DPC): All commissioning tasks executed during the design phase of the project.

Environmental Systems: Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

Executive Summary: A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

Functionality: This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Industry Accepted Best Practice: A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of

utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

Lessons Learned Workshop: A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

Maintainability: A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

Owner's Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Peer Review: A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review.

Precision: The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT's include installation verification and system and component start up tests.

Procedure or Protocol: A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

Range: The upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.

Resolution: This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

Site Observation Reports (SO): Reports of site inspections and observations made by the Commissioning Agent. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

Special System Inspections: Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

Static Tests: Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

Start Up Tests: Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

Systems Manual: A system-focused composite document that includes all information required for the owners operators to operate the systems.

Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

Training Plan: A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

Trending: Monitoring over a period of time with the building automation system.

Unresolved Commissioning Issue: Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team. **Validation:** The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

Whole Building Commissioning: Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

1.7 SYSTEMS TO BE COMMISSIONED

- A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the Operation and Maintenance personnel, is required in cooperation with the Commissioning Agent.
- B. The following systems will be commissioned as part of this project:

Systems To Be Commissioned	
System	Description
Plumbing	
Domestic Water Distribution	Backflow preventers, potable water storage tanks
Domestic Hot Water Systems	Hot water heat pumps, circulation pumps
Wastewater Pump Systems	Sump pumps
HVAC	
Noise and Vibration Control	Noise and vibration levels for critical equipment such as Air Handlers, Chillers, Cooling Towers, Boilers, Generators, etc. will be commissioned as part of the system commissioning
HVAC Ventilation/Exhaust Systems	General exhaust, toilet exhaust, laboratory exhaust, isolation exhaust, room pressurization control systems
HVAC Terminal Unit Systems	fan coil units, unit heaters
Variable Refrigerant Flow Manufacturer's Controls	Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
Decentralized Unitary HVAC Systems	Split-system HVAC systems, controls
Table Notes	

1.8 COMMISSIONING TEAM

- A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the Commissioning Agent.
- B. Members Appointed by Contractor:
 - 1. Contractor's Commissioning Manager: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.

2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

C. Members:

1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process.
2. User: Representatives of the facility user and operation and maintenance personnel.
3. A/E: Representative of the Architect and engineering design professionals.

1.9 (NOT USED)

1.10 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

- A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.
- B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.
- C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
 1. Participate in commissioning coordination meetings.
 2. Conduct operation and maintenance training sessions in accordance with approved training plans.
 3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
 5. Review and comment on commissioning documentation.
 6. Participate in meetings to coordinate Systems Functional Performance Testing.
 7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
 8. Provide information to the Commissioning Agent for developing commissioning plan.
 9. Participate in training sessions for operation and maintenance personnel.
 10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.11 COMMISSIONING AGENT'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.
- C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.
- D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.
- E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.
- F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.
- G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.
- H. Coordinate Systems Functional Performance Testing schedule with the Contractor.
- I. Witness selected systems startups.
- J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.
- K. Witness and document Systems Functional Performance Testing.
- L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.
- M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.
- N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
- O. Prepare commissioning Field Observation Reports.

- P. Prepare the Final Commissioning Report.
- Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.
- R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.12 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
 - 2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 - 3. Identification of systems and equipment to be commissioned.
 - 4. Schedule of Commissioning Coordination meetings.
 - 5. Identification of items that must be completed before the next operation can proceed.
 - 6. Description of responsibilities of commissioning team members.
 - 7. Description of observations to be made.
 - 8. Description of requirements for operation and maintenance training.
 - 9. Schedule for commissioning activities with dates coordinated with overall construction schedule.
 - 10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
 - 11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
 - 12. Preliminary Systems Functional Performance Test procedures.

- B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the Architect/Engineer and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
1. Name and identification code of tested system.
 2. Test number.
 3. Time and date of test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Dated signatures of the person performing test and of the witness, if applicable.
 6. Individuals present for test.
 7. Observations and Issues.
 8. Issue number, if any, generated as the result of test.
- C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.
- D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.
- E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.

1. Creating a Commissioning Issues Log Entry:

- a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
- b. Assign a descriptive title for the issue.
- c. Identify date and time of the issue.
- d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.
- e. Identify system, subsystem, and equipment to which the issue applies.
- f. Identify location of system, subsystem, and equipment.
- g. Include information that may be helpful in diagnosing or evaluating the issue.
- h. Note recommended corrective action.
- i. Identify commissioning team member responsible for corrective action.
- j. Identify expected date of correction.
- k. Identify person that identified the issue.

2. Documenting Issue Resolution:

- a. Log date correction is completed or the issue is resolved.
- b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
- c. Identify changes to the Contract Documents that may require action.
- d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
- e. Identify person(s) who corrected or resolved the issue.
- f. Identify person(s) verifying the issue resolution.

G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during occupancy and operation. It shall describe

components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
 2. Commissioning plan.
 3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
 4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
 5. Commissioning Issues Log.
 6. Listing of deferred and off season test(s) not performed, including the schedule for their completion.
- H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:
1. Documentation of deferred and off season test(s) results.
 2. Completed Systems Functional Performance Test Procedures for off season test(s).
 3. Documentation that unresolved system performance issues have been resolved.
 4. Updated Commissioning Issues Log, including status of unresolved issues.
 5. Identification of potential Warranty Claims to be corrected by the Contractor.
- I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:
1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
 2. Reference to Final Commissioning Plan.
 3. Reference to Final Commissioning Report.
 4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.13 SUBMITTALS

- A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary

Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:

1. The Commissioning Team: A list of commissioning team members by organization.
 2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size.
 3. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.
 4. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
 5. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.
 6. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.
 7. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.
- B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan.
- C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor for review and comment. The Contractor shall return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

- D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.
- E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the Contractor and the Architect/Engineer.
- F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the Contractor and Architect.
- G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.
- H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report. The final submittal will incorporate comments.
- I. Data for Commissioning:
 - 1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.
 - 2. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

1.14 COMMISSIONING PROCESS

- A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the Contractor. As directed by the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.
- B. The Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.
- C. The Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all

Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.15 QUALITY ASSURANCE

- A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.16 COORDINATION

- A. Management: The Commissioning Agent will coordinate the commissioning activities with the Contractor. The Commissioning Agent will submit commissioning documents and information. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.
- B. Scheduling: The Contractor shall work with the Commissioning Agent to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction.
- C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.
- D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

- E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.
- F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS**2.1 TEST EQUIPMENT**

- A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.
- B. Data logging equipment and software required to test equipment shall be provided by the Contractor.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES

A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Construction Commissioning Kick Off meeting	L	A	P	P	O	
	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Controls Meeting	L	A	P	P	O	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD.	L	A	P	P	N/A	
Cx Plan & Spec	Final Commissioning Plan	L	A	R	R	O	
Schedules	Duration Schedule for Commissioning Activities	L	A	R	R	N/A	

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Construction Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	TAB Plan Review	L	A	R	R	O	
	Submittal and Shop Drawing Review	R	A	R	L	O	
	Review Contractor Equipment Startup Checklists	L	A	R	R	N/A	
	Review Change Orders, ASI, and RFI	L	A	R	R	N/A	
Site Observations	Witness Factory Testing	P	A	P	L	O	
	Construction Observation Site Visits	L	A	R	R	O	
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R	O	
	Final Functional Performance Test Protocols	L	A	R	R	O	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	

B. The following table outlines the roles and responsibilities for the Commissioning Team members during the Acceptance Phase:

Acceptance Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Pre-Test Coordination Meeting	L	A	P	P	O	
	Lessons Learned and Commissioning Report Review Meeting	L	A	P	P	O	

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Acceptance Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov’t Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD	L	P	P	P	O	
Cx Plan & Spec	Maintain/Update Commissioning Plan	L	A	R	R	O	
Schedules	Prepare Functional Test Schedule	L	A	R	R	O	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R	O	
	Pre-Functional Checklist Verification	L	A	R	R	O	
	Review Operations & Maintenance Manuals	L	A	R	R	R	
	Training Plan Review	L	A	R	R	R	
	Warranty Review	L	A	R	R	O	
	Review TAB Report	L	A	R	R	O	
Site Observations	Construction Observation Site Visits	L	A	R	R	O	
	Witness Selected Equipment Startup	L	A	R	R	O	

Acceptance Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Functional Test Protocols	TAB Verification	L	A	R	R	O	
	Systems Functional Performance Testing	L	A	P	P	P	
	Retesting	L	A	P	P	P	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
	Systems Training	L	S	R	P	P	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	
	Final Commissioning Report	L	A	R	R	R	
	Prepare Systems Manuals	L	A	R	R	R	

C. The following table outlines the roles and responsibilities for the Commissioning Team members during the Warranty Phase:

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Warranty Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov’t Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Post-Occupancy User Review Meeting	L	A	O	P	P	
Site Observations	Periodic Site Visits	L	A	O	O	P	
Functional Test Protocols	Deferred and/or seasonal Testing	L	A	O	P	P	
Technical Activities	Issues Resolution Meetings	L	S	O	O	P	
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	L	A		R	P	
Reports and Logs	Final Commissioning Report Amendment	L	A		R	R	
	Status Reports	L	A		R	R	

3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

- A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.
1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.
 - a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.
 - b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.
 2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.
 - a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - b. The full startup plan shall at a minimum consist of the following items:
 - 1) The Pre-Functional Checklists.
 - 2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - 3) The manufacturer's normally used field checkout sheets.
 - c. The Commissioning Agent will submit the full startup plan to the Contractor for review.
 - d. The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.
 3. Sensor and Actuator Calibration
 - a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 22 and Division 23 specifications.

- b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
- 4. Execution of Equipment Startup
 - a. The Contractor shall schedule startup and checkout with the Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
 - b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
 - c. The Contractor shall execute startup and provide the Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
 - d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP

- A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the Commissioning Agent within two days of completion.
- B. The Commissioning Agent will review the report and submit comments. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system.
- C. The Contractor shall be responsible for resolution of deficiencies.

3.4 PHASED COMMISSIONING

- A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the Commissioning Agent and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.5 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.
- B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the Architect/Engineer and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.
- D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:
 - 1. System and equipment or component name(s)
 - 2. Equipment location and ID number

3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
 4. Date
 5. Project name
 6. Participating parties
 7. A copy of the specification section describing the test requirements
 8. A copy of the specific sequence of operations or other specified parameters being verified
 9. Formulas used in any calculations
 10. Required pretest field measurements
 11. Instructions for setting up the test.
 12. Special cautions, alarm limits, etc.
 13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
 14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
 15. A section for comments.
 16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.
- E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
 2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.

3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
 5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.
- F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.
- G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.
- H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days' notice to the Commissioning Agent regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

- J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.
- K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.6 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

- A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.
- B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the Contractor/Engineer on Commissioning Field Reports and/or the Commissioning Master Issues Log.
 - 1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
 - 2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so.
 - 3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor.
 - 4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
 - a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the

- b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.

5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:

- a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
- b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed.
- c. The Commissioning Agent will document the resolution process.
- d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable. In such case, the Contractor shall provide the following:

1. Within one week of notification, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The Engineer shall determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution shall be installed by the Contractor shall be allowed to test the installations for up to one week, upon which the Engineer will decide whether to accept the solution.
 5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent. The Commissioning Agent will evaluate each test and report using a standard form. The Engineer will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.7 DEFERRED TESTING

- A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the Contractor and Engineer.
- B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.8 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include Engineer, Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of Operations and Maintenance personnel.

- B. The Contractor shall provide training and demonstration as required by other Division 22 and Division 23 sections. The Training and Demonstration shall include, but is not limited to, the following:
1. Review the Contract Documents.
 2. Review installed systems, subsystems, and equipment.
 3. Review instructor qualifications.
 4. Review instructional methods and procedures.
 5. Review training module outlines and contents.
 6. Review course materials (including operation and maintenance manuals).
 7. Review and discuss locations and other facilities required for instruction.
 8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
- C. Training Module Submittals: The Contractor shall submit the following information to the Commissioning Agent:
1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for use.
 2. Qualification Data: Submit qualifications for facilitator and/or instructor.
 3. Attendance Record: For each training module, submit list of participants and length of instruction time.
 4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
 5. Demonstration and Training Recording:
 - a. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
 - b. Video Format: Provide high quality color DVD color on standard size DVD disks.
 - c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
 - d. Narration: Describe scenes on video recording by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed.

Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

- e. Submit two copies within seven days of end of each training module.
- 6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.
- D. Quality Assurance:
 - 1. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
 - 2. Instructor Qualifications: A factory authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
 - 3. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.
- E. Training Coordination:
 - 1. Coordinate instruction schedule with operations. Adjust schedule as required to minimize disrupting operations.
 - 2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
 - 3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved.
- F. Instruction Program:
 - 1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
 - a. Fire protection systems, including fire alarm, fire pumps, and fire suppression systems.
 - b. Intrusion detection systems.
 - c. Conveying systems, including elevators, wheelchair lifts, escalators, and automated materials handling systems.
 - d. Medical equipment, including medical gas equipment and piping.
 - e. Laboratory equipment, including laboratory air and vacuum equipment and piping.

- f. Heat generation, including boilers, feedwater equipment, pumps, steam distribution piping, condensate return systems, heating hot water heat exchangers, and heating hot water distribution piping.
 - g. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
 - h. HVAC systems, including air handling equipment, air distribution systems, and terminal equipment and devices.
 - i. HVAC instrumentation and controls.
 - j. Electrical service and distribution, including switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
 - k. Packaged engine generators, including synchronizing switchgear/switchboards, and transfer switches.
 - l. Lighting equipment and controls.
 - m. Communication systems, including intercommunication, surveillance, nurse call systems, public address, mass evacuation, voice and data, and entertainment television equipment.
 - n. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.
- G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:
- 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - H. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.

- f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning

- e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.
- H. Training Execution:
 - 1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
 - 2. Instruction:
 - a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor or number of participants, instruction times, and location.
 - b. Instructor: Engage qualified instructors to instruct personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the Commissioning Agent with at least seven days' advance notice.
 - 4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
 - 5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.
- I. Demonstration and Training Recording:
 - 1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
 - 2. Video Format: Provide high quality color DVD color on standard size DVD disks.

3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

----- END -----

SECTION 02 41 00 - DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of portions of buildings, utilities, other structures and debris shown.

1.2 RELATED WORK:

- A. Excavation of roads, walks, curbs, and on-grade slabs outside buildings to be demolished:
Section 31 23 16 - EXCAVATION
- B. Safety Requirements: Section 01 35 26 Safety Requirements Article, ACCIDENT PREVENTION PLAN (APP).
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Owner: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Asbestos Removal: Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- F. Lead Paint: Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
- G. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- H. Construction Waste Management: Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.
- I. Infectious Control: Section 01 35 26, SAFETY REQUIREMENTS.

1.3 PROTECTION:

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
 - 2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Owner; any damaged items shall be repaired or replaced as approved by the Owner's Representative. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Owner's Representative's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS and Section 01 35 26, SAFETY REQUIREMENTS.

1.4 UTILITY SERVICES:

- A. Demolish and remove site utility service lines shown to be removed.
- B. Remove abandoned site utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION:

- A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new utility service lines.
 - 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him off-site at frequency necessary to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Owner's Representative. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
- D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash accumulation/storage areas on site. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the trash accumulation/storage areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.
- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Owner's Representative. When Utility lines are encountered that are not indicated on the drawings, the Owner's Representative shall be notified prior to further work in that area.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Owner's Representative. Clean-up shall include off-site disposal of all items and

materials not required to remain property of the Owner as well as all debris and rubbish resulting from demolition operations.

END OF SECTION 02 41 00

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.

- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Concrete repair procedures.
- k. Concrete protection.
- l. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- m. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Performance-based hydraulic cement
- 7. Aggregates.
- 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 9. Vapor retarders.
- 10. Floor and slab treatments.
- 11. Liquid floor treatments.
- 12. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 13. Joint fillers.
- 14. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Calculated equilibrium unit weight, for lightweight concrete.
- 6. Slump limit.
- 7. Air content.
- 8. Nominal maximum aggregate size.
- 9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

10. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
 11. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
 12. Intended placement method.
 13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect and Engineer.
- D. Samples: For vapor retarder
- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Fiber reinforcement.
 4. Curing compounds.
 5. Floor and slab treatments.
 6. Bonding agents.
 7. Adhesives.
 8. Vapor retarders.
 9. Semirigid joint filler.
 10. Joint-filler strips.

11. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:

a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I or Type II.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

- C. Normal-Weight Aggregates: ASTM C33 coarse aggregate or better, graded. Provide aggregates from a single source.

- D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

- F. Water and Water Used to Make Ice: ASTM C94, potable

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F : Any color.
 - c. Ambient Temperature Above 85 deg F : White.
- D. Curing Paper: Eight-feet- wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.

3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.8 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 3000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 4 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

B. Class B: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Minimum Cementitious Materials Content: 470 lb/cu. yd.
5. Slump Limit: 5 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

C. Class C: Normal-weight concrete used for exterior slabs-on-ground.

1. Exposure Class: ACI 318 F2.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 470 lb/cu. yd.
5. Slump Limit: 5 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
6. Air Content:
 - a. 6 percent, plus or minus 1.5 percent at point of delivery

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
 - 4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
 - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Do not place concrete floors and slabs in a checkerboard sequence.

2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch (6 mm) in one direction.
 3. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish:
 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 3. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish:
 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Architect before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

- a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

d. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.9 TOLERANCES

- A. Conform to ACI 117.

3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than seven days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 4. Rinse with water; remove excess material until surface is dry.
 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s).
 2. Do not fill joints until construction traffic has permanently ceased.

- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 3. After concrete has cured at least 14 days, correct high areas by grinding.
 - 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 - 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 - 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.

- b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- D. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- E. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

- a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd, but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:

- a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:

- a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 (ACI 301M), section 1.6.6.3.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.14 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 03 33 00 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place architectural concrete, including form facings, reinforcement accessories, concrete materials, concrete mixtures, concrete placement, and concrete finishes.
2. Requirements in Section 03 30 00 "Cast-in-Place Concrete" apply to this Section.

1.2 DEFINITIONS

- A. Aggregate Exposure: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.
- B. Cast-in-Place Architectural Concrete: Concrete that is exposed to view, is designated as architectural concrete, and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- C. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- D. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- E. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Form-facing panels.
2. Form joint tape.
3. Wood sealer.
4. Form-release agent.
5. Form ties.
6. Aggregates.
7. Admixtures:

- a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Calculated equilibrium unit weight, for lightweight concrete.
 6. Slump limit.
 7. Air content.
 8. Nominal maximum aggregate size.
 9. Amounts of mixing water to be withheld for later addition at Project site if permitted.
 10. Intended placement method.
 11. Alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Samples: For each of the following materials:
1. Form-facing panels.
 2. Form ties.
 3. Form liners, 12-by-12-inch Sample, indicating texture.
 4. Exposed aggregates.
 5. Chamfers and rustications.

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Installer Qualifications: An experienced cast-in-place architectural concrete installer, as evidenced by not less than five consecutive years' experience, specializing in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
1. Provide written evidence of qualifications and experience.
 2. Include locations, descriptions, and photographs of completed projects, including name of architect, substantiating the quality of the installer's experience.

- C. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.
1. Locate panels as indicated or, if not indicated, as directed by Architect.
 2. Demonstrate methods of curing, aggregate exposure, wood sealers, and coatings, as applicable.
 3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove field sample panels when directed.
- D. Mockups: Before casting architectural concrete, build mockups, using the same procedures, equipment, materials, finishing procedures, and curing procedures that will be used for producing architectural concrete, to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, color, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 2. Build mockups of typical wall of cast-in-place architectural concrete as shown on Drawings, including vertical and horizontal rustication joints, and any sculptured features.
 3. Construct mockups to include at least two lifts having heights equal to those anticipated for construction.
 4. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
 5. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair to match adjacent undamaged surfaces.
 6. In presence of Architect, demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 7. Obtain Architect's approval of mockups before casting architectural concrete.
 8. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 FORM-FACING MATERIALS

- A. Comply with Section 03 10 00 "Concrete Forming and Accessories" for formwork and other form-facing material requirements, and as specified in this Section.
- B. Form-Facing Panels for As-Cast Finishes:
 - 1. Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1 , or Finnish phenolic overlaid birch plywood.
- C. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.
- D. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch thick.
- E. Wood Sealer: Penetrating, clear, polyurethane wood sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood and does not stain, does not adversely affect concrete surfaces, and does not impair subsequent treatments and finishes of concrete surfaces.
- F. Form-Release Agent: Commercially formulated, colorless form-release agent that does not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments and finishes of architectural concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes no larger than 3/4 inch in diameter on architectural concrete surface.
 - 2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches from architectural concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 CONCRETE MIXTURES, GENERAL

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs, based on laboratory trial mixtures.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.4 CONCRETE MIXTURES

- A. Class K : Normal-weight concrete.
 1. Exposure Class: ACI 318 F3 S1 W1 C1 .
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.46.
 4. Air Content:
 - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size .
 5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.5 CONCRETE MIXING

- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
 1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 2. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 3. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 4. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with Section 03 10 00 "Concrete Forming and Accessories" for formwork, embedded items, and shoring and reshoring, and as specified in this Section.
- B. Limit deflection of form-facing panels to not exceed ACI 301 requirements.
- C. Limit cast-in-place architectural concrete surface irregularities, as follows:
 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

- D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117.
- E. Seal form joints, chamfers, rustication joints, and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 1. Provide closure backing materials if indented rustication is used over a ribbed form line, and seal joint between rustication strip and form with joint sealant.
- F. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- G. Coat contact surfaces of wood rustications and chamfer strips with wood sealer before placing reinforcement, anchoring devices, and embedded items.
- H. Coat contact surfaces of forms with form-release agent, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.
- I. Coat contact surfaces of forms with surface retarder, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

3.2 INSTALLATION OF REINFORCEMENT AND ACCESSORIES

- A. Comply with Section 03 20 00 "Concrete Reinforcing" for fabricating and installing steel reinforcement and accessories.

3.3 JOINTS

- A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
 - 2. Form keyed joints as indicated. Align construction joint within rustications attached to form-facing material.
 - 3. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated on Drawings . Unless otherwise indicated on Drawings, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

3.4 CONCRETE PLACEMENT

- A. Comply with Section 03 30 00 "Cast-in-Place Concrete."

3.5 FINISHING FORMED SURFACES

- A. Comply with Section 03 30 00 "Cast-in-Place Concrete."
- B. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- C. As-Cast Surface Finishes: Comply with Section 03 30 00 "Cast-in-Place Concrete" for the following:
 - 1. ACI 301 Surface Finish-1.0 (SF-1.0.)
 - 2. ACI 301 Surface Finish-2.0 (SF-2.0.)
 - 3. ACI 301 Surface Finish-3.0 (SF-3.0.)

3.6 CONCRETE CURING

- A. Comply with Section 03 30 00 "Cast-in-Place Concrete" using identical curing procedures to that used for mockups.

3.7 REPAIR

- A. Comply with ACI 301.
- B. Repair damaged finished surfaces of cast-in-place architectural concrete when repairing is approved by Architect.
- C. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
- D. Remove and replace cast-in-place architectural concrete that cannot be repaired to Architect's approval.

3.8 FIELD QUALITY CONTROL

- A. Comply with Section 03 30 00 "Cast-in-Place Concrete."

3.9 CLEANING

- A. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- B. Wash and rinse surfaces in accordance with concrete finish applicator's written instructions.

1. Protect other Work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

3.10 PROTECTION

- A. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- B. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

3.11 FINAL ACCEPTANCE

- A. Final acceptance of completed architectural concrete Work will be determined by Architect by comparing approved mockups with installed Work, when viewed at a distance of 20 feet .

END OF SECTION 03 33 00

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry-joint reinforcement.
 - 5. Embedded flashing.
 - 6. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Cast-stone trim in concrete unit masonry.
- C. Related Requirements:
 - 1. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
 - 3. Section 089516 "Wall Vents" for wall vents (brick vents).

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include data on material properties.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Integral water repellant used in CMUs.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
- E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops the indicated net-area compressive strengths at 28 days in the Structural drawings.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested

according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) ACM Chemistries.
- 2) Euclid Chemical Company (The); an RPM company.
- 3) Moxie International.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,800 psi
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

- B. Hydrated Lime: ASTM C207, Type S.

- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

- D. Masonry Cement: ASTM C91/C91M.

- E. Mortar Cement: ASTM C1329/C1329M.

- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Davis Colors.
- b. Solomon Colors, Inc.

- G. Aggregate for Mortar: ASTM C144.

- H. Aggregate for Grout: ASTM C404.

- I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

- J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- K. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch diameter.
 - 5. Spacing of Cross Rods: Not more than 16 inches o.c.
 - 6. Provide in lengths of not less than 10 feet.

2.7 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
 - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
 - 3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
 - 4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 - 5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Adjustable Anchors: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire.
 - 2. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication.

- a. 0.064-inch-thick, galvanized sheet may be used at interior walls unless otherwise indicated.
3. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

2.8 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Use one of the following unless otherwise indicated:
 1. Copper-Laminated Flashing: 7-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
 2. Asphalt-Coated Copper Flashing: 7-oz./sq. ft. copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
 3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
 - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch.
 - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch thick.
- B. Application: Unless otherwise indicated, use the following:
 1. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
 2. Where flashing is fully concealed, use flexible flashing.
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
 - 3. For exterior masonry, use portland cement-lime masonry cement or mortar cement mortar.
 - 4. For reinforced masonry, use portland cement-lime masonry cement or mortar cement mortar.
 - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For mortar parge coats, use Type S.
 - 4. For exterior, above-grade, nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C476,
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.
 - 4. Provide minimum compressive strength indicated in the Structural drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Wet joint surfaces thoroughly before applying mortar.
 - 3. Rake out mortar joints for pointing with sealant.
- D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.

3.9 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.

6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.10 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

- A. Special Inspections and field quality control testing: Owner will engage a qualified special inspector to perform field tests and inspections and prepare test reports.
1. Refer to drawings for testing and special inspection requirements.
 2. Prepare and submit reports within 7 days of completing tests and inspections. Distribute reports to Architect, Engineer, Owner (or owner's representative), and Contractor. Clearly indicate non-compliance on reports.
- B. Non-Compliant Work:
1. The contractor shall remove and replace all non-compliant work, or, at the contractor's expense, perform additional testing to verify compliance. Contractor shall submit results of

additional testing to Architect, Engineer, and Owner (or owner's representative) for review and approval.

3.12 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION 042200

SECTION 04 26 13 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Accessories.
6. Mortar mixes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type and color of brick .

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product.

1.4 MOCKUPS

- A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 40 00 "Quality Requirements" for mockups.
1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.

1.5 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

2.2 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216 , Grade SW , .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acme Brick Company.
 - b. Belden Brick Company (The).
 - c. Boral Bricks, Inc; Boral Limited.
 - d. Endicott Clay Products Co.
 - e. Glen-Gery Corporation.
 - 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
 - 3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 - 4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 5. Color and Texture: As selected by Architect.

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Preblended Dry Mortar Mix: Packaged blend made from or masonry cement, sand, and admixtures and complying with ASTM C1714/C1714M.

1. Preblended Dry Portland Cement Mortar Mix:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Quikrete; The QUIKRETE Companies, LLC.
 - 2) Sakrete; CRH Americas, Oldcastle APG.
 - 3) SPEC MIX, LLC.
 2. Preblended Dry Masonry Cement Mortar Mix:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Amerimix is a trademark of Bonsal American, an Oldcastle company.
 - 2) SPEC MIX, LLC.
- C. Aggregate for Mortar: ASTM C144.
1. White-Mortar Aggregates: Natural white sand or crushed white stone.
 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- D. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C , and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Euclid Chemical Company (The); an RPM company.
 - b. GCP Applied Technologies Inc.
- E. Water: Potable.

2.4 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Stainless Steel Wire: ASTM A580/A580M, Type 304 .
- C. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
 2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0781-inch- thick, stainless steel sheet .

3. Fabricate wire ties from 0.187-inch- diameter, stainless steel wire unless otherwise indicated.
4. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hohmann & Barnard, Inc.
5. Masonry-Veneer Anchors; Single-Barrel Screw: Self-drilling, single-barrel screw designed to receive wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity .
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hohmann & Barnard, Inc.
6. Masonry-Veneer Anchors; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with thermally resistant wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity .
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hohmann & Barnard, Inc.
7. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.5 EMBEDDED FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 , 0.016 inch thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 4. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
- B. Flexible Flashing: Use the following unless otherwise indicated:

1. Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric, to produce an overall thickness of 40 mil.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hohmann & Barnard, Inc.
 2. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a permanent, clear adhesive, to produce an overall thickness of 10 mil .
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hohmann & Barnard, Inc.
 - 2) VaproShield LLC.
 - b. Applications: Use 10-mil- thick flashing at windows, doors, and small wall penetrations; not at base of walls. Use 40-mil- thick flashing at base of walls.
- C. Drainage Plane Flashing: Fabricate from stainless steel and drainage membrane to shapes indicated , including weep tabs, termination bar and drip edge. Provide flashing materials as follows:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mortar Net Solutions.
 2. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 , 0.016 inch thick.
 3. Elastomeric Membrane: EPDM complying with ASTM D4637/D4637M , 40 mil .
 4. Fabricate continuous flashings in sections 60 inches long, minimum.
- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- E. Termination Bars for Flexible Flashing: Stainless steel steel bars 1/8 inch by 1 inch .

2.6 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Weep/Vent Products: Use the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Advanced Building Products Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Mortar Net Solutions.
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity and 16 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hohmann & Barnard, Inc.
 - 2) Mortar Net Solutions.
 2. Rainscreen Drainage Mat: Sheets or strips not less than 3/4 inch thick and installed to full height of cavity, with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity to prevent weep holes from clogging with mortar.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advanced Building Products Inc.
 - 2) Keene Building Products.
 - 3) Mortar Net Solutions.

2.7 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp,

unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
- 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.

C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
- 2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch .

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond ; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Embed tie sections in masonry joints.
 - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
 - 5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
 - 6. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.
- B. Provide not less than 1 inch of airspace between back of masonry veneer and face of sheathing or insulation.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches.
 3. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
 4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
 5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
 1. Use specified weep/cavity vent products to form weep holes.
 2. Space weep holes 24 inches o.c. unless otherwise indicated.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.
- E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.
 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Testing Prior to Construction: One set of tests.
- D. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

3.9 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 2. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.10 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 26 13

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Shrinkage-resistant grout.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Anchor rods.
 - 4. Threaded rods.
 - 5. Shop primer.

6. Galvanized-steel primer.
 7. Galvanized repair paint.
 8. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
 5. Identify members not to be shop primed.
- C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 341.
 - 3. ANSI/AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
 - b. Use Allowable Stress Design; data are given at service-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992, Grade 50
- B. Channels, Angles: ASTM A36
- C. Plate and Bar: ASTM A36.

- D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
 - 1. Nuts: ASTM A563 hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 4. Finish: Plain.
- C. Threaded Rods: ASTM A36.
 - 1. Nuts: ASTM A563 hex carbon steel.
 - 2. Washers: ASTM A36 carbon steel.
 - 3. Finish: Plain.

2.5 PRIMER

- A. Steel Primer:
 - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer:

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780

2.6 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3 for interior exposure and SSPC-SP 6 for exterior exposure.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 3.
 - 2. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect[and test] shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- 1) Liquid Penetrant Inspection: ASTM E165/E165M.
- 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
- 3) Ultrasonic Inspection: ASTM E164.
- 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
1. Hollaender Mfg. Co.
 2. Kee Safety, Inc.
 3. Trex Commercial Products, Inc.
 4. Tuttle, a Dant Clayton Division.
 5. VIVA Railings, LLC.
 6. Wagner Companies (The); R&B Wagner, Inc.
- B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Woven-Wire Mesh Infill Panels: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.134-inch- diameter steel wire complying with ASTM A510.
1. Basis-of-Design Product: Provide product with crimp pattern matching Newark Wire Works, Inc. Plain Weave.

2.4 FASTENERS

- A. Fastener Materials:
1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/ASTM F1941M, Class Fe/Zn 5 for zinc coating.
 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
- B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast iron center of handrail 2-1/2 inches from wall.

- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- H. Intermediate Coats and Topcoats: Provide products that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- I. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- J. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- L. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- F. Form changes in direction as follows:
1. By bending or wending with properly fitted miters and notches.
- G. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- H. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- K. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 2. Coordinate anchorage devices with supporting structure.
- L. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- M. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames.
1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
 2. Orient wire mesh with wires perpendicular and parallel to top rail.

- N. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

1. Comply with SSPC-SP 16.

- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.

1. Exterior Railings: SSPC-SP 6/NACE No. 3.
2. Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
3. Railings Indicated To Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
4. Other Railings: SSPC-SP 3.

- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.
2. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members.

3.3 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- B. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
- C. Install railing gates level, plumb, and secure for full opening without interference.

3.4 CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 52 13

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking , cants, and nailers.
4. Wood furring.
5. Wood sleepers.
6. Utility shelving.
7. Plywood backing panels.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent 15 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any species.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
 1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
 2. Eastern softwoods, No. 2 Common grade; NELMA.
 3. Northern species, No. 2 Common grade; NLGA.
 4. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C Exterior, C-C Plugged Exposure 1, C-D Plugged , in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Screws for Fastening to Metal Framing: ASTM C1002 , length as recommended by screw manufacturer for material being fastened.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.

- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Subflooring.
5. Underlayment.
6. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:

1. Product Data: For installation adhesives, indicating VOC content.
2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 WALL SHEATHING (INTERIOR)

A. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing.

2.4 COMBINATION WALL SHEATHING, AIR AND WATER-RESISTIVE BARRIER
(EXTERIOR NON-INSULATED SHEATHING)

- A. Oriented-Strand-Board Wall Sheathing: With integral water-resistive barrier, Exposure 1 sheathing.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; ZIP System® Wall Sheathing or an approved equivalent.
 2. Span Rating, Panel Grade and Performance Category: Not less than 24/16; Structural 1, 7/16 Performance Category.
 3. Edge Profile: Self-spacing profile.
 4. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 16-inches on centers spacing.
 5. Performance Standard: DOC PS2-10 and ICC-ES ESR-1474.
 6. Factory laminated integral water-resistive barrier facer.
 7. Perm Rating of Integral Water-Resistive Barrier: 12-16 perms.
 8. Assembly maximum air leakage of 0.0072 cfm/sq. ft. infiltration and 0.0023 cfm/ sq. ft. exfiltration at a pressure differential of 1.57.
 9. Exposure Time: Designed to resist weather exposure for 180 days.

2.5 COMBINATION ROOF SHEATHING AND ROOF UNDERLAYMENT

- A. Oriented-Strand-Board Roof Sheathing: With integral water-resistive barrier, Exposure 1, Structural I sheathing.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; ZIP System® Roof and Wall Sheathing or approve equivalent.
 2. Span Rating, Panel Grade and Performance Category: Not less than 32/16; Structural 1; 1/2 Performance category.
 3. Edge Profile: Self-spacing profile.
 4. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 16-inches and 24-inches on center spacing.
 5. Performance Standard: DOC PS2-10 and ICC-ES ESR-1473.
 6. Factory laminated integral roofing underlayment facer.
 7. Exposure Time: Designed to resist weather exposure for 180 days.
- B. Panel Edge Clips: Provide panel edge clips approved for application in accordance with code approvals and panel manufacturer's written instructions.
- C. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing with integral Air and Water-Resistive Barrier.

2.6 PARAPET SHEATHING

- A. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing with integral Air and Water-Resistive Barrier.

2.7 SUBFLOORING

- A. Oriented-Strand-Board Combination Subfloor-Underlayment: Exposure 1 single-floor panels.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; AdvanTech Flooring or approved equivalent.
 2. Span Rating and Performance Category: Not less than 24 oc, 23/32 Performance Category.
 3. Edge Detail: Tongue and groove.
 4. Surface Finish: Fully sanded face.
 5. Performance Standard: DOC PS2-10 and ICC-ES ESR-1785 (24 oc, 23/32 Performance Category).
 6. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 16-inches 19.2-inches and 24-inches on center spacings.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For roof parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
 2. For roof parapet and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

2.9 MISCELLANEOUS MATERIALS

- A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, proprietary seam tape consisting of polyolefin film with acrylic adhesive.
1. Basis-of-Design Product: Subject to compliance with requirements provide Huber Engineered Woods; ZIP System® Seam and Flashing Tape or approved equivalent:
 2. Thickness: 0.012 inch 3.75 inch 6 inch
 3. Code Compliance: Comply with requirements of authorities having jurisdiction and ICC Evaluation Service, Inc. "AC148 - Acceptance Criteria for Flexible Flashing Materials."
 4. International Code Council (ICC), ICC-ES ESR2227.
 5. American Architectural Manufacturer's Association; AAMA 711.
- B. Liquid-Applied Flashing Membrane: Gun-grade, cold-applied, silyl-terminated polyether (STPE) liquid flashing membrane compatible with sheathing/weather barrier and self-adhering seam and flashing tape, and tested as part of an assembly meeting performance requirements. Follow manufacturer's recommendation for integration with self-adhering seam and flashing tape.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods; ZIP System® Liquid Flash or an approved equivalent.
 2. Hardness, Shore A, ASTM C 661: 40 to 45.
 3. Total Solids: 99 percent.

4. Tensile Strength, ASTM D 412: 75 psi.
- C. Self-Adhering Flexible Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, flexible flashing tape consisting of a flexible acrylic foam backing with acrylic adhesive.
1. Basis-of-Design Product: Subject to compliance with requirements provide Huber Engineered Woods; ZIP System® Stretch Tape or approved equivalent.
 2. Thickness: 0.042 inch.
 3. Width: 6 inch.
 4. Code Compliance: Comply with requirements of authorities having jurisdiction and ICC Evaluation Service, Inc. "AC148 - Acceptance Criteria for Flexible Flashing Materials."
 5. International Association of Plumbing and Mechanical Officials (IAPMO), IAPMO ER365.
 6. American Architectural Manufacturer's Association; AAMA 711.
- D. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
1. Verify adhesive has a VOC content of 50 g/L or less.

2.10 MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.
- D. Coordinate wall parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Subflooring:
 - a. Glue and nail to wood framing.
 - b. Space panels 1/8 inch apart at edges and ends.
 - 2. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 06 16 00

SECTION 06 16 13 - INSULATING SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating wall sheathing with integral water-resistive barrier and air barrier.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME): www.asme.org
 - 1. ASME B18.6.1 - Wood Screws (Inch Series)
- B. ASTM International (ASTM): www.astm.org
 - 1. ASTM A153/A153M - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 2. ASTM C1289 - Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 - 3. ASTM D779 - Test Method for Water Resistance of Paper, Paperboard, and Other Sheet Materials by the Dry Indicator Method
 - 4. ASTM D1621 - Test Method for Compressive Properties Of Rigid Cellular Plastics
 - 5. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 - 6. ASTM E96/E 96M - Test Methods for Water Vapor Transmission of Materials
 - 7. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 - 8. ASTM E2357 - Test Method for Determining Air Leakage of Air Barrier Assemblies
 - 9. ASTM F1667 - Specification for Driven Fasteners: Nails, Spikes, and Staples
 - 10. ASTM G154 - Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
- C. US Department of Commerce (DOC): <http://gsi.nist.gov/global/index.cfm/L1-5/I2-44/A-355>
 - 1. DOC PS 2 - Performance Standard for Wood-Based Structural Panels
- D. International Code Council (ICC): www.iccsafe.org
 - 1. ICC IBC - International Building Code
 - 2. ICC IRC - International Residential Code for One and Two-Family Dwellings
- E. ICC Evaluation Service, Inc. (ICC-ES): www.icc-es.org
 - 1. ICC-ES AC12 - Acceptance Criteria For Foam Plastic Insulation
 - 2. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers
 - 3. ICC-ES AC116 - Acceptance Criteria for Nails and Spikes

4. ICC-ES AC148 - Acceptance Criteria For Flexible Flashing Materials
5. ICC-ES AC201 - Acceptance Criteria for Staples
6. ICC-ES AC269 - Acceptance Criteria for Racking Shear Evaluation of Proprietary Sheathing Materials attached to Light-Frame Wall Construction or Code-Complying Sheathing Attached to Light-Framed Walls with Proprietary Fasteners
7. ICC-ES AC310 - Acceptance Criteria for Water-Resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-Resistive Barriers
8. ICC-ES ESR-1539 - Power Driven Staples and Nails for Use in Engineered and Non-Engineered Connections
9. ICC-ES NER-272 - Power Driven Staples and Nails for Use in All Types of Building Construction

F. Sustainable Forestry Initiative (SFI): www.sfiprogram.org/

1. SFI 2010 - 2014 Standard

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of sheathing product specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: From ICC-ES, for wood sheathing and seam tape.
- B. Product Certifications: From manufacturer, indicating that sheathing products comply with ICCES AC269 and ICC-ES AC310.
- C. Certified Wood Certificates: Certificates indicating that manufacturer is currently certified by an SFI- or FSC- accredited certification body, and chain-of-custody certificates indicating that sheathing products comply with forest certification requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty: Executed copy of manufacturer special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide wood products from manufacturer certified by SFI, FSC, or comparable sustainable forestry program acceptable to Architect.
- B. Provide wall sheathing products meeting requirements for water-resistive barrier in accordance with ICC-ES AC310.
- C. Provide wall sheathing products meeting requirements of ICC-ES AC269.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for protection of sheathing products from weather prior to installation.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which sheathing manufacturer agrees to repair or replace sheathing products that demonstrate deterioration or failure under normal use due to manufacturing defects within warranty period specified, when installed according to manufacturer's instructions.
 - 1. Warranty Period for Sheathing Products: 30 years following date of Substantial Completion.
 - 2. Warranty Conditions: Special warranties exclude deterioration or failure due to structural movement resulting in stresses on sheathing products exceeding manufacturer's written specifications, or due to air or moisture infiltration resulting from cladding failure or mechanical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide sheathing products manufactured by Huber Engineered Woods LLC, Charlotte NC; Phone: (800) 933-9220; Website: www.zipsystem.com or, approved equivalent.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Assembly Air Leakage: Less than 0.04 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.2 L/s x sq. m at 75 Pa), per ASTM E2375.
- B. Water-Vapor Permeance, Facer: Minimum 12 perms (689 ng/Pa x s x sq. m), ASTM E96/E96M.
- C. Weather Exposure: Manufacturer warranty applies for maximum allowable exposure period of 180 days.

2.3 MATERIALS

- A. Oriented Strand Board: DOC PS 2, made with binder containing no added urea formaldehyde.
- B. Rigid Foam Plastic Insulating Board: Rigid polyisocyanurate foam core complying with ASTM C1289 Type II, Class 2, and ICC-ES AC12, with coated glass fiber facers on both sides, with the following characteristics:
 - 1. Nominal Density: 2.0 pcf (32 kg/cu. m).

2. Compressive Strength, ASTM D1621: Not less than 20 psi (150 kPa).
3. Vapor Permeance, ASTM E96/E96M: Less than 1.0 perm.
4. Edge Configuration: Square finished.

2.4 COMPOSITE INSULATING WALL SHEATHING

- A. Composite Insulating Wall Sheathing: Oriented-strand-board Exposure 1 sheathing 7/16 inch (11.1 mm) thick, with factory-laminated water-resistive barrier exterior facer, and with rigid foam plastic insulating board laminated to interior face.
1. Basis-of-Design Product: Provide Huber Engineered Woods LLC; ZIP System R Sheathing.
 2. Span Rating and Performance Category of Sheathing Layer: Not less than 24/16; 7/16 Performance Category.
 3. Thickness: 1-1/2 inch (38 mm).
 4. Thermal Resistivity (R Value): 6.6 deg F x h x sq. ft./Btu x in. at 75 deg F (46 K x m/W at 24 deg C).
 5. Edge Profile: Square edge.
 6. Exterior Facer: Medium-density, phenolic-impregnated polymer-modified sheet material meeting requirements for ASTM D779 Grade D weather-resistive barrier in accordance with ICC AC38 and AC310, with fastener spacing symbols on exterior facer for 16-inch (406 mm) and 24-inch (610 mm) on center spacing, with the following characteristics
 - a. Water Resistance of Coatings, ASTM D2247: Pass 14 day exposure test.
 7. Moisture Vapor Transmission, ASTM E96: Not less than 12 perms.
 8. Water Penetration, ASTM E331: Pass at 2.86 lbf/sq. ft. (137 Pa).
 9. Wind Driven Rain, TAS-100: Pass.
 10. Accelerated Weathering, ASTM G154: Pass.

2.5 FASTENERS

- A. Fasteners, General: Size and type complying with manufacturer's written instructions for Project conditions and requirements of authorities having jurisdiction.
1. Corrosion Resistance: Hot-dip zinc coating, ASTM A153/A 153M .
- B. Nails, Brads, and Staples: ICC AC116 and ICC AC201.
- C. Power-Driven Fasteners: ICC-ES-1539 or NER-272.
- D. Wood Screws: ASME B18.6.1.

2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIAL

- A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, seam tape consisting of polyolefin film with acrylic adhesive, meeting ICC AC148.
1. Basis-of-Design Product: Provide Huber Engineered Woods; ZIP System Tape.
 - a. Thickness: 0.012 inch (0.3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing spacing and alignment to determine if work is ready to receive sheathing. Proceed with sheathing work once conditions meet requirements.

3.2 SHEATHING INSTALLATION

- A. Install sheathing panels in accordance with manufacturer's written instructions, requirements of applicable Evaluation Reports, and requirements of authorities having jurisdiction.
- B. Air and Moisture Barrier: Coordinate sheathing installation with flashing and joint sealant installation and with adjacent building air and moisture barrier components to provide complete, continuous air- and moisture- barrier.
- C. Do not bridge expansion joints; allow joint spacing equal to spacing of structural supports.
- D. Install panels with laminated facer to exterior. Stagger end joints of adjacent panel runs.
- E. Attach sheathing panels securely to substrate with manufacturer-approved fasteners in compliance with the following:
 - 1. ICC-ES ESR-1539 or ICC-NES NER-272 for power-driven fasteners.
 - 2. IBC: Table 2304.9.1 Fastening Schedule.
 - 3. IRC: Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments."
- F. Apply seam tape at all panel seams, penetrations, and facer defects or cracks to form continuous weathertight surface. Apply tape according to manufacturer's written instructions and requirements of ICC-ES applicable to tape application.

END OF SECTION 06 16 13

SECTION 06 16 26 - UNDERLAYMENT

PART 1 - PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Magnesium Oxide (MgO) Panels for use as underlayment and as part of a fire-rated and sound-attenuating assembly.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of underlayment product. Include manufacturer's technical data indicating performance properties.
- B. Shop Drawings: Indicating location and extent of underlayment and assemblies. Include details of joints, corners, and penetrations.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: From ICC NTA for underlayment products.
- B. Product Certifications: From manufacturer, indicating that underlayment products comply with indicated Performance Criteria.
- C. Warranty: Sample unexecuted copy of manufacturer warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty: Executed copy of manufacturer warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for storage prior to installation.
 - 1. Store panels horizontally and fully supported.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which underlayment manufacturer agrees to repair or replace products that demonstrate deterioration or failure under normal use due to manufacturing defects within warranty period, when installed according to manufacturer's instructions.
 - 1. Warranty Period for Underlayment Products: 10-years from date of manufacture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Resistance Assembly in accordance with UL263 Design No L601 or L602
 - 1. Rating: 1-Hour Fire Resistant Assembly
- B. Bare Sound Rating:
 - 1. STC: 56
 - 2. IIC: 41
 - 3. HIIC: 40
- C. Structural Design Values
 - 1. Maximum Allowable Uniform Loading (satisfies L/360 LL and L/240 TL deflection – 3 span condition. Panel long dimension perpendicular to floor framing and edges supported by framing.
 - 2. Joist/Truss spacing 16 inches on center: 120 psf LL/ 140 psf TL
 - 3. Joist/Truss spacing 19.2 inches on center: 100 psf LL/ 120 psf TL
 - 4. Joist/Truss spacing 24 inches on center 70 psf LL / 90 psf TL
 - 5. Maximum Allowable Diaphragm Capacity (unblocked): 360 plf

2.2 BASIS OF DESIGN

- A. EXACOR™ Subfloor by Huber Engineered Woods LLC, Charlotte NC; Phone: (800) 933-9220; Website: www.EXACOR.com.
- B. Substitutions: Only products approved by the architect will be acceptable. Submit the following listed items (2-5) with proper documentation as required for substitution requests. Allow an additional (15) working days for any substitution review in addition to the standard review time for submittals.
- C. Request for substitutions must follow the requirements in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.

2.3 MAGNESIUM OXIDE SUBFLOOR

- A. Physical Characteristics
 - 1. Thickness: 3/4-inch (20mm) nominal
 - 2. Panel Size: 48 by 96 inches (1220 by 2440mm) nominal
 - 3. Edge profile: Tongue and Groove
- B. Fire-Resistant Characteristics in accordance with ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
 - 1. Flame Spread: 0

2. Smoke Developed: 0

C. Water Vapor Permeable:

1. ASTM E96 – Standard Test Methods for Water Vapor Transmission
 - a. Greater than or equal to 13 perms according to ASTM E96 Method B
 - b.

D. Mold Resistance: No mold growth observed in accordance with ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

2.4 FASTENERS

A. Fasteners, General: Size and type complying with manufacturer's written instructions for Project conditions and requirements of authorities having jurisdiction.

B. Nails:

1. Annular Ring shank nails with shank diameter of 0.113 inches
2. Minimum #6 by 2 inch (50.8 mm)
3. Corrosion Resistant: Powder coated, or Stainless Steel
4. Conform with ICC-ES AC116 - Acceptance Criteria for Nails and Spikes and ICC-ES AC201 Acceptance Criteria for Staples

C. Screws:

1. Minimum #8 by 2 inch (50.8 mm)
2. Corrosion Resistant: Powder coated, or Stainless Steel
3. ICC-ES ESR-1539 - Power Driven Staples and Nails for Use in Engineered and Non-Engineered Connections or ICC-ES NER-272 - Power Driven Staples and Nails for Use in All Types of Building Construction

D. Adhesive:

1. Polyurethane or solvent-based
2. Panel manufacturer and adhesive manufacturer recommended for indicated use
3. Conforms with ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Structural Panels to Wood Based Floor System Framing and APA AFG-01 - Adhesives for Field-Gluing Plywood to Wood Framing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing spacing and alignment to determine if work is ready to receive underlayment. Proceed with underlayment work once conditions meet requirements.

1. Confirm flatness is within tolerances required for flooring.

3.2 MAGNESIUM OXIDE BOARD UNDERLAYMENT INSTALLATION

A. Underlayment Installation, General:

1. Install underlayment in accordance with manufacturer's written instructions, requirements of applicable Evaluation Reports; Fire-Resistant Assembly; Sound rated assembly, and requirements of authorities having jurisdiction.
2. Support shiplap edges of EXACOR underlayment with framing or blocking in accordance with local building code requirements and joist/truss manufacturer.
3. Utilize 2 by blocking flatwise between framing members to provide panel edge support.
4. Install blocking with top surface flush with the top of floor framing members to provide uniform support for underlayment panels.
5. Maintain designed expansion joints through underlayment. Do not bridge designed expansion joints in structural panel underlayment.
6. Coordinate termite and decay protection when EXACOR underlayment to be installed within 8 inches of exposed earth.

B. Installation:

1. Glue and nail to wood framing or subfloor
2. Mechanical Fastening Pattern:
 - a. Edges: 6 inches on center
 - b. Field of panel: 12 inches on center
 - c. Place fasteners no closer than ½ inch to the edge
 - d. Place fastener no closer to the corner than 2 inches.
 - e. Fastener penetration:
 - 1)
 - 2) Nails to penetrate 1 framing members 1.25 inch minimum
3. Do not bridge expansion joints
4. Long direction of panels to span a minimum of two joists, short end to be supported over framing and additional blocking for shiplap edges.
5. Butt panel edges together. Stagger end joints of adjacent panel runs.

3.3 PROTECTION AND REPAIR

- A. Protect exposed board surfaces from damage due to high construction traffic and concentrated loads during construction.
- B. Patch small gaps (less than 2 sq inches) and divots in underlayment with elastomeric patching compound
- C. Where large repairs are required, cut out damaged area and replace with piece of underlayment, installing in same manner as initial installation. Apply patching compound to transition between board and patch.

3.4 PREPARATION OF FINISH FLOOR COVERINGS

- A. Remove dust, dirt and debris from underlayment surface. Ensure panel surface is free from water, oil, grease and other contaminants.

- B. Verify underlayment mechanical fasteners are flush with panel face or slightly below.
- C. Identify and correct imperfections in the surface and repair damage as indicated above.
- D. Proceed with specific finish preparation prior to installation of flooring finish.

END OF SECTION 06 16 26

SECTION 06 20 13 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior wood medium-density overlay (MDO) primed hardboard trim.
2. Lumber Plywood Engineered wood siding.
3. Engineered wood soffits.

1.2 DEFINITIONS

- A. MDO: Plywood with a medium-density overlay on the face.
- B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

1.5 WARRANTY

- A. Manufacturer's Warranty for Engineered Wood Siding Soffits and Trim: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Factory-Applied Finish: Five years from date of Substantial Completion.
 2. Warranty Period for Siding Soffits and Trim (Excluding Finish): 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American

Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece , or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

2.2 EXTERIOR TRIM

A. Lumber Trim for Painted Finish:

1. Species and Grade: Eastern white pine, eastern hemlock-balsam fir-tamarack, eastern spruce, or white woods; NeLMA, NLGA, WCLIB, or WWPA D Select (Quality) .
2. Maximum Moisture Content: 15 percent.
3. Finger Jointing: Allowed if made with wet-use adhesive complying with ASTM D5572.
4. Face Surface: Surfaced (smooth) .
5. Factory Priming: Factory coated on both faces and all edges, with exterior primer compatible with topcoats specified.

B. MDO Trim: Exterior Grade B-B MDO plywood.

C. Primed Hardboard Trim: ANSI A135.6, primed with manufacturer's standard exterior primer. Recommended by manufacturer for exterior use.

2.3 ENGINEERED WOOD SIDING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Georgia-Pacific Gypsum LLC.

B. Engineered Wood Siding: ANSI A135.6, primed with manufacturer's standard exterior primer.

1. Type: 7/16-inch- thick, square-edge flat panels; without grooves.
2. Texture: Smooth .

C. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.4 ENGINEERED WOOD SOFFITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Georgia-Pacific Gypsum LLC.

- B. Engineered Wood Soffits: ANSI A135.6, primed with manufacturer's standard exterior primer.
 - 1. Type: 7/16-inch- thick flat panels, smooth .
 - 2. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails .
 - 2. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
 - 3. For pressure-preservative-treated wood, provide stainless steel fasteners.
 - 4. For applications not otherwise indicated, provide stainless steel aluminum fasteners.
- B. Flashing: Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.
 - 1. Horizontal Joint Flashing for Panel Siding: Preformed, stainless steel, Z-shaped flashing.
- C. Insect Screening for Soffit Vents: Aluminum, 18-by-16-inch black mesh .
- D. Continuous Soffit Vents: Aluminum hat channel shape with perforations, 2 inches wide and in lengths not less than 96 inches .
 - 1. Net-Free Area: 9 sq. in./linear ft. .
 - 2. Finish: White paint .
- E. Sealants: Latex, complying with ASTM C834 Type OP, Grade NF and applicable requirements in Section 07 92 00 "Joint Sealants," and recommended by sealant and substrate manufacturers for intended application.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bostik; Arkema.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.
 - 1. Cut to required lengths and prime ends.
 - 2. Comply with requirements in Section 09 91 13 "Exterior Painting."

3.2 INSTALLATION, GENERAL

- A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut exterior finish carpentry to fit adjoining work.
 - 3. Refinish and seal cuts as recommended by manufacturer.
 - 4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
 - 6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger end joints in adjacent and related members.
- C. Fit exterior joints to exclude water.
 - 1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
 - 2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
- D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.4 INSTALLATION OF SIDING

- A. Install siding to comply with manufacturer's written instructions and warranty requirements.
- B. Horizontal Lumber Siding:
 - 1. Apply starter strip along bottom edge of sheathing or sill.

2. Install first course of siding, with lower edge at least 1/8 inch below starter strip and subsequent courses lapped 1 inch over course below.
 - a. Nail at each stud.
 - b. Do not allow nails to penetrate more than one thickness of siding.
3. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

C. Diagonal Lumber Siding:

1. Begin application at corner, with tongue edge up.
2. Install subsequent courses with tongue-and-groove edges tightly fitted together.
 - a. Nail at each stud.
3. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

D. Plywood Siding:

1. Install panels with edges over framing or blocking.
2. Nail at 6 inches o.c. at panel perimeter and 12 inches o.c. at intermediate supports unless manufacturer recommends closer spacing.
3. Leave 1/16-inch gap between adjacent panels and 1/8-inch gap at perimeter, openings, and horizontal joints unless otherwise recommended by panel manufacturer.
4. Seal butt joints at inside and outside corners and at trim locations.
5. Install continuous metal flashing at horizontal panel joints.
6. Apply battens and corner trim as indicated. Countersink nail heads, fill flush, and sand filler.
7. Conceal fasteners to greatest practical extent by countersinking and filling, by placing in grooves of siding pattern or by concealing with applied trim or battens as detailed.
 - a. Do not nail through overlapping pieces.

E. Engineered Wood Siding:

1. Install engineered wood siding to comply with manufacturer's written instructions.
2. Install panels with edges over framing or blocking.
3. Leave 3/16-inch gap at perimeter, openings, and horizontal panel joints unless otherwise recommended by panel manufacturer.
4. Seal butt joints at inside and outside corners and at trim locations.
5. Install continuous metal flashing at horizontal panel joints.
6. Apply battens and corner trim as indicated.
7. Conceal fasteners to greatest practical extent by placing in grooves of siding pattern or by concealing with applied trim or battens as detailed.

- F. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.
- G. Finish: Apply finish within two weeks of installation.

END OF SECTION 06 20 13

SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Interior hardboard paneling.
3. Shelving and clothes rods.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.
- D. MDF: ANSI A208.2, Grade 130.

- E. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - 1. Color: As selected by Architect from manufacturer's full range .

2.2 INTERIOR TRIM

- A. Lumber Trim for Opaque Finish (Painted Finish):
 - 1. Species and Grade:
 - a. Alder, aspen, basswood, cottonwood, gum, magnolia, soft maple, sycamore, tupelo, or yellow poplar; NHLA A Finish .
 - 2. Maximum Moisture Content for softwoods: 15 percent.
 - 3. Maximum Moisture Content for Hardwoods: 10 percent.
 - 4. Finger Jointing: Allowed .
 - 5. Face Surface: Surfaced (smooth) .
 - 6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

2.3 PANELING

- A. Hardboard Paneling: Interior factory-finished hardboard paneling complying with ANSI A135.5.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Chesapeake Plywood LLC.
 - b. Marlite, Inc.
 - 2. Thickness: 1/4 inch.
 - 3. Finish: Class I .
 - 4. Surface-Burning Characteristics: As follows, tested according to ASTM E84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 5. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.4 SHELVING AND CLOTHES RODS

- A. Exposed Closet Utility Shelving: Made from the following material , 3/4 inch thick:
 - 1. MDO softwood plywood with solid-wood edge.
- B. Shelf Cleats: 3/4-by-3-1/2-inch boards , as specified above for shelving .
- C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&M Hardware, Inc.
 - b. EPCO, Engineered Products Co.
 - c. Knape & Vogt Manufacturing Company.
 - D. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&M Hardware, Inc.
 - b. EPCO, Engineered Products Co.
 - c. Knape & Vogt Manufacturing Company.
 - E. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.
 - F. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel .
 - G. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; powder-coat-finished steel.
 - H. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; powder-coat-finished steel.
 - I. Wood Clothes Rods: 1-1/2-inch- diameter, clear, kiln-dried .
 - J. Metal Clothes Rods: 1-5/16-inch- diameter, color-coated-steel tubes .
 - K. Metal Rod Flanges: Aluminum .
- 2.5 MISCELLANEOUS MATERIALS
- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
 - B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
 - C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.
 - D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

06 20 23 - 3

- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 24 inches long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 - 7. Install trim after gypsum-board joint finishing operations are completed.
 - 8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
 - 9. Fasten to prevent movement or warping.
 - 10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 INSTALLATION OF PANELING

- A. Hardboard Paneling: Install according to manufacturer's written instructions.
 - 1. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings.
 - 2. Butt adjacent panels with moderate contact.
 - 3. Use fasteners with prefinished heads matching paneling color.
 - 4. Wood Stud or Furring Substrate: Install with 1-inch annular-ring shank hardboard nails.

5. Plaster or Gypsum-Board Substrate: Install with 1-5/8-inch annular-ring shank hardboard nails.
6. Nailing: Space nails 4 inches o.c. at panel perimeter and 8 inches o.c. at intermediate supports unless otherwise required by manufacturer.

3.5 INSTALLATION OF SHELVING AND CLOTHES RODS

- A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.
 1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
 2. Space fasteners not more than 16 inches o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal in width and wider.
 3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
 4. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.
- D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.
 1. Install shelves, fully seated on cleats, brackets, and supports.
 2. Fasten shelves to cleats with finish nails or trim screws, set flush.
 3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.
- F. Install rod flanges for rods as indicated.
 1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
 2. Install rods in rod flanges.

END OF SECTION 06 20 23

SECTION 06 40 13 - EXTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior standing and running trim.
2. Exterior frames and jambs.
3. Wood furring, blocking, shims, and hanging strips for installing exterior architectural woodwork items that are not concealed within other construction.
4. Shop priming of exterior architectural woodwork.
5. Shop finishing of exterior architectural woodwork.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Wood-Preservative Treatment:
 - a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - b. Indicate type of preservative used and net amount of preservative retained.
 - c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
2. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

- ##### B. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

- ##### A. Qualification Data: For architectural woodwork manufacturer and Installer.

1.5 CLOSEOUT SUBMITTALS

- ##### A. Quality Standard Compliance Certificates: certificates.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program .
- B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program .
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical exterior architectural woodwork as shown on Drawings .
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of exterior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
 - a. This project has been registered with AWI as AWI Quality Certification Program Number .
 - b. Contractor shall register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 800-345-0991.
- B. Regional Materials: Wood products shall be manufactured within 500 miles of Project site.

2.2 EXTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Architectural Woodwork Standards Grade: Custom .
- B. Backout or groove backs of flat trim members, and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- C. Wood Species: Any closed-grain hardwood .
 - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
 - 2. Wood Moisture Content: 9 to 15 percent.

2.3 EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

- A. Architectural Woodwork Standards Grade: Custom .

B. Wood Species: Any closed-grain hardwood .

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content: 9 to 15 percent.

2.4 WOOD MATERIALS

A. Hardboard: ANSI A135.4.

2.5 PRESERVATIVE-TREATED-WOOD MATERIALS

A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWWA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative-Treated Wood Materials: Treat wood materials unless otherwise indicated on Drawings .

1. Items fabricated from the following wood species need not be treated:
 - a. Redwood .
 - b. Western red cedar .
 - c. White oak.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Use stainless steel unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless steel fasteners.
3. For redwood, use stainless steel fasteners.

B. Nails: ASTM F 1667.

C. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

D. Carbon-Steel Bolts: ASTM A 307 hex nuts and, where indicated, flat washers all hot-dip zinc coated.

- E. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2; with ASTM F 594, Alloy Group ASTM F 594, Alloy Group 1 or 2M, Grade A1 or Grade A4 hex nuts and, where indicated, flat washers.
- F. Postinstalled Anchors: Stainless steel, anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E 488/E 488M conducted by a qualified independent testing and inspecting agency.
 - 1. Stainless steel bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

- A. Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
 - 1. Wood-Preservative Treatment: By pressure process, AWPAC U1; Use Category UC3b.
 - a. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
 - b. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
 - 2. Fire-Retardant Treatment: Complying with requirements; provide where indicated on Drawings .
- B. Adhesives: Do not use adhesives that contain urea formaldehyde.
- C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.8 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate exterior architectural woodwork to dimensions, profiles, and details indicated.
 - 1. Ease edges to radius indicated for the following:
 - a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
 - b. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
 - 1. Disassemble components only as necessary for shipment and installation.
 - 2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
 - 3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

- a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
- b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.9 SHOP PRIMING

- A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior architectural woodwork, as applicable to each unit of work.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.
- C. Exterior Architectural Woodwork for Opaque Finish: Shop prime all surfaces with one coat of wood primer as specified in Section 09 91 13 "Exterior Painting."
- D. Exterior Architectural Woodwork for Transparent Finish:
 1. Shop seal surfaces to be concealed
 2. Shop seal exposed surfaces with stain (if specified), other required pretreatments, and first coat of finish as specified in Section 09 93 00 "Staining and Transparent Finishing."

2.10 SHOP FINISHING

- A. Finish exterior architectural woodwork indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior architectural woodwork, as applicable to each unit of work.
 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of exterior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish: Comply with Section 09 93 00 "Staining and Transparent Finishing."
- D. Opaque Finish: Comply with Section 09 91 13 "Exterior Painting."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition exterior architectural woodwork to average prevailing humidity conditions at Project site.

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- B. Before installing exterior architectural woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

- A. Grade: Install exterior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble exterior architectural woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install exterior architectural woodwork level, plumb, true in line, and without distortion.
 - 1. Shim as required with concealed shims.
 - 2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Standing and Running Trim:
 - 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
 - 2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
 - 3. Scarf running joints and stagger in adjacent and related members.
- E. Scribe and cut exterior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Preservative-Treated Wood Materials: Where field cut or drilled, treat cut ends and drilled holes according to AWWA M4.
- G. Anchor exterior architectural woodwork to anchors or blocking built in or directly attached to substrates.
 - 1. Secure with countersunk, concealed fasteners and blind nailing.
 - 2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with exterior architectural woodwork.
 - 3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
 - 4. For shop-finished items, use filler matching finish of items being installed.
- H. Touch up finishing work specified in this Section after installation of exterior architectural woodwork.
 - 1. Fill nail holes with matching filler where exposed.
 - 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.
- I. Field Finishing: See Section 09 91 13 "Exterior Painting" for final finishing of installed exterior architectural woodwork.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 06 40 13

SECTION 06 61 16 - SOLID SURFACING FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide solid surfacing fabrications including but not limited to following:
- B. window sills.

1.2 REFERENCES

- A. Abbreviations and Acronyms:
- B. LEED®: Leadership in Energy and Environmental Design; www.cagbc.org.
- C. MDF: Medium Density Fiberboard.
- D. SCAQMD: South Coast Air Quality Management District; www.aqmd.gov.
- E. VOC: Volatile Organic Compound.
- F. Definitions:
 - 1. Solid Surface: Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.
- G. Reference Standards:
 - 1. ANSI/NPA A208.2-09 - Medium Density Fiberboard (MDF) For Interior Applications
 - 2. ASTM C920-14a - Standard Specification for Elastomeric Joint Sealants
 - 3. ASTM D638-10 - Standard Test Method for Tensile Properties of Plastics
 - 4. ASTM D785-08 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
 - 5. ASTM D790-10 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 6. ASTM D5420-10 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
 - 7. ASTM E84-14 - Standard Test Method for Surface Burning Characteristics of Building Materials
 - 8. ASTM E228-11 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer
 - 9. ASTM G21-13 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

10. ASTM G22-76(96) - Standard Practice for Determining Resistance of Plastics to Bacteria
11. ASTM G155-13 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
12. NFPA 255-06 - Standard Method of Test of Surface Burning Characteristics of Building Materials
13. NSF/ANSI 51-07 - Food Equipment Materials
14. SCAQMD Rule 1168 - Adhesive and Sealant Applications (amended January 2005)
15. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials
16. UL Environment/ - Standard for Chemical Emissions for Building Materials, GREENGUARD - Finishes and Furnishings, Section 7.1UL 2818
17. UL Environment/ - Gold Standard for Chemical Emissions for Building Materials, GREENGUARD - Finishes and Furnishings, Section 7.1 and 7.2UL 2818
18. UL 2824 - GREENGUARD Certification Program, Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Architect. Presided over by Contractor, include Architect who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.4 SUBMITTALS

- A. Product Data: Indicate Product description including solid surface sheets illustrating full range of standard colors, fabrication information and compliance with specified performance requirements. Submit Product data with resistance to list of chemicals.
- B. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00 Indicate plans, sections, dimensions, component sizes, edge details, thermosetting requirements, fabrication details, attachment provisions, sizes of furring, blocking, including concealed blocking and coordination requirements with adjacent work.
- C. Samples: Submit samples in accordance with Section 01 30 00 Submit minimum 6" x 6" samples. Cut sample and seam together for representation of inconspicuous seam. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work.
- D. Test and Evaluation Reports: Submit flammability test reports

1.5 CLOSEOUT SUBMITTALS

- A. Operational and Maintenance Data:
- B. Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.
- C. Provide a commercial care and maintenance kit and video. Review maintenance procedures and warranty details with Owner upon completion.

1.6 QUALITY ASSURANCE

- A. Qualifications:
- B. Installers: Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- C. Mock-Ups:
- D. Prior to final approval of Shop Drawings, erect 1 full size mock-up of each component at Project site demonstrating quality of materials and execution for Architect review.
- E. Should mock-up not be approved, rework or remake until approval is secured. Remove rejected units from Project site.
- F. Approved mock-up will be used as standard for acceptance of subsequent work.
- G. Approved mock-ups may remain as part of finished work.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are ready for installation.
- B. Storage and Handling Requirements:
 - 1. Store components indoors prior to installation.
 - 2. Handle materials to prevent damage to finished surfaces.

1.8 WARRANTY

- A. Manufacturer Warranty: Provide manufacturer's standard warranty for material only for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Architect and at no expense to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer List: Products may include the following manufacturers. Other manufacturers may be acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
1. Corian® by DuPont; www.corian.com
 2. Samsung Chemical USA; www.staron.com
 3. Wilsonart Contract; www.wilsonartcontract.com
- B. Substitution Limitations: This Specification is based on Corian® Products. Comparable Products from other manufacturers will be accepted provided they meet requirements of this Specification.

2.2 MATERIALS

- A. Performance/Design Criteria:

B. Property	Requirement	Test Procedure	(min or max)
1. Solid Surface Based Products:			
a. Tensile Strength	6000 psi min	ASTM D638	
b. Tensile Modulus	1.5 x 10 ⁶ psi min	ASTM D638	
c. Tensile Elongation	0.4% min.	ASTM D638	
d. Flexural Strength	10000 psi min	ASTM D790	
e. Flexural Modulus	1.2 x 10 ⁶ psi min	ASTM D790	
f. Hardness	>85-Rockwell "M" scale min.	ASTM D785	
g. Thermal Expansion	2.2 x 10 ⁻⁵ in./in./°F	ASTM E228	
h. Fungi and Bacteria	Does not support microbial growth	ASTM G21 & G22	
i. Microbial Resistance	Highly resistant to mold growth	UL 2824	
j. Ball Impact	No fracture - 1/2 lb. Ball: 6 mm slab - 36" drop 12 mm slab - 144" drop	Method 3.8	NEMA LD 3, 12 mm slab -
k. Weatherability	ΔE*94<5 in 1,000 hrs	ASTM G155	
l. Flammability	& UL 723	ASTM E84, NFPA 255	
m. All Colors			
1) 6 mm	12 mm		
n. Flame Spread	<25	<25	
o. Smoke Developed	<25	<25	
p. Class	A	A NFPA 101®, Life Safety Code	

- C. Solid Surface Material:

- D. Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction; meeting following criteria:
- E. Flammability: Class 1 and A when tested to UL 723.
- F. Adhesive for Bonding to Other Products: One component silicone to ASTM C920.
- G. Sealant: A standard mildew-resistant, FDA/UL® recognized silicone color matched sealant or clear silicone sealants.

2.3 COMPONENTS

- A. Window Sills: 1/2" thick solid surfacing material, adhesively joined with inconspicuous seams, edge shall be double thickness, details as indicated on Drawings. Color selected later by Architect from manufacturer's full color range.
- B. Fabrication:
 - 1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and solid polymer manufacturer requirements. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
 - 2. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.
 - 3. Ensure no blistering, whitening and cracking of components during forming.
 - 4. Fabricate backsplashes from solid surfacing material with optional radius cove where counter and backsplashes meet as indicated on Drawings. Backsplashes for most colors may be fabricated by traditional means discussed in K-25294 Backsplashes. Colors with metallic/mica particle or veined colors creating directional aesthetics (K-26833 Directional Aesthetics) may require the techniques in Technical Bulletin K-28235 Thermoformed Backsplash.
 - 5. Fabricate joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide reinforcing strip of solid polymer material under each joint. Reinforcing strip of solid polymer material is not required when using DuPont™ Joint Adhesive 2.0.
 - 6. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.
 - 7. Finish: Ensure surfaces have uniform finish:
 - a. Matte, with a 60° gloss rating of 5 - 20.
 - 8. Fabrication Tolerances:
 - a. Variation in Component Size: +/-1/8".
 - b. Location of Openings: +/-1/8" from indicated location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.
2. Verify actual site dimensions and location of adjacent materials prior to commencing work.
3. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to within 1/8" in 10' - 0".
4. Notify Architect in writing of any conditions which would be detrimental to installation.

B. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2 INSTALLATION

A. Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed Shop Drawings and Product installation details.

B. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.

C. Route radii and contours to template. Anchor securely to base component or other supports. Align adjacent components and form seams to comply with manufacturer's written recommendations using adhesive in color to match work. Carefully dress joints smooth, remove surface scratches and clean entire surface.

D. Seal between wall and components with joint sealant as specified herein and in Section 07 92 .00, as applicable.

E. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Ensure components are clean on date of Substantial Completion of the Work.

3.3 REPAIR

A. Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer's "Technical Bulletins".

3.4 SITE QUALITY CONTROL

- A. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

3.5 CLEANING

- A. Remove excess adhesive and sealant from visible surfaces.
- B. Clean surfaces in accordance with manufacturer's "Care and Maintenance Instructions".

3.6 PROTECTION

- A. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.
- B. Protect surfaces from damage until date of Substantial Completion of the Work.

END OF SECTION 06 61 16

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood roof trusses.
 - 2. Wood floor trusses.
 - 3. Wood girder trusses.

1.3 ALLOWANCES

- A. Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Section 012100 "Allowances."

1.4 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For wood-preservative-treated lumber, fire-retardant-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification from treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.

- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 5. Show splice details and bearing details.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For metal connector-plate manufacturer, professional engineer, and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
 - 1. Metal-plate connectors.
 - 2. Metal truss accessories.

1.7 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that

periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated.
 - 2. Maximum Deflection of Roof and Floor Trusses under Design Loads:
 - a. Live Load Deflection: Vertical deflection of 1/480 of span.
 - b. Total Load Deflection: Vertical deflection of 1/360 of span.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Provide dressed lumber, S4S.
 - 3. Provide dry lumber with 15 percent maximum moisture content at time of dressing.

- B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for both top and bottom chords.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
 - 1. Use for interior locations unless otherwise indicated.

2.4 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated of basis-of-design products of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Floor Truss Hangers: U-shaped hangers, full depth of floor truss, with 1-3/4-inch-long seat; formed from metal strap 0.062 inch thick with tabs bent to extend over and be fastened to supporting member.
- D. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.7 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.8 SOURCE QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
 - 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
 - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not comply with requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A780/A780M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual

truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 061753

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, emulsified-asphalt dampproofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. APOC, Inc; a division of Gardner Industries.
2. Brewer Company (The).
3. Euclid Chemical Company (The); an RPM company.
4. Henry Company.
5. Master Builders Solutions.
6. W. R. Meadows, Inc.

- B. Trowel Coats: ASTM D 1227, Type II, Class 1.

2.3 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
 - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 - 2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.
- D. Where dampproofing interior face of above-grade, exterior concrete and masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one trowel coat at not less than 4 gal./100 sq. ft..
- B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or primer and one trowel coat at not less than 5 gal./100 sq. ft..
- C. Concrete Backup for Brick Veneer Assemblies and Dimension Stone Cladding: Apply one brush or spray coat at not less than 1 gal./100 sq. ft..
- D. Masonry Backup for Brick Veneer Assemblies and Dimension Stone Cladding: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..

- E. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..

END OF SECTION 07 11 13

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type V : ASTM C578, Type V, 100-psi minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont de Nemours, Inc.
 - b. Owens Corning.
 - c. The Dow Chemical Company.
2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

- A. Polyisocyanurate Board Insulation, Foil Faced : ASTM C1289, foil faced, Type I, Class 1 or 2.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. DuPont de Nemours, Inc.
 - c. Firestone Building Products.
 - d. Hunter Panels.
 - e. Johns Manville; a Berkshire Hathaway company.
 - f. The Dow Chemical Company.
 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.4 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced : ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Owens Corning.
 - c. ROCKWOOL.
 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
 2. Press units firmly against inside substrates.
 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For wood-framed construction, install blankets according to ASTM C1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 07 21 00

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

B. Related Requirements:

1. Section 07 57 00 "Coated Foamed Roofing" for spray polyurethane foam insulation used for roofing applications.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Spray Foam Insulation.
 - b. Henry Company.
 - c. Johns Manville; a Berkshire Hathaway company.
2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

END OF SECTION 07 21 19

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building paper.
2. Building wrap.
3. Flexible flashing.
4. Drainage material.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.
- B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D.
- C. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; or comparable product by one of the following:
 - a. Kingspan Insulation LLC.
 - b. The Dow Chemical Company.
 - c. DuPont de Nemours, Inc.
 2. Water-Vapor Permeance: Not less than 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 3. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

- D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

- A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; or comparable product by one of the following:
 - a. Protecto Wrap Company.
 - b. Raven Industries, Inc.
 - c. DuPont de Nemours, Inc.
 - 2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch 0.040 inch.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fortifiber Building Systems Group; or comparable product by one of the following:
 - a. Advanced Building Products Inc.
 - b. MFM Building Products Corp.
 - c. Polyguard Products, Inc.
 - d. Fortifiber Building Systems Group.
 - 2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

2.3 DRAINAGE MATERIAL

- A. Drainage Material: Product shall maintain a continuous open space between water-resistive barrier and exterior cladding to create a drainage plane and shall be used under siding portland cement plaster adhered masonry veneer.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; or comparable product by one of the following:
 - a. Advanced Building Products Inc.
 - b. Insulfoam; Carlisle Construction Materials Company.
 - c. Keene Building Products.
 - d. DuPont de Nemours, Inc.
 - 2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- B. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.
- C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 - 2. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 3. Lap water-resistive barrier over flashing at heads of openings.

3.3 DRAINAGE MATERIAL INSTALLATION

- A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 07 25 00

SECTION 07 26 00 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reinforced-polyethylene vapor retarders.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for under-slab vapor retarders.
2. Section 07 21 00 "Thermal Insulation" for vapor retarders integral with insulation products.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 REINFORCED-POLYETHYLENE VAPOR RETARDERS

- A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 20 lb/1000 sq. ft. , with maximum permeance rating of 0.1 perm.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Raven Industries, Inc.
 - b. Reef Industries, Inc.
 - c. W. R. Meadows, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 07 26 00

SECTION 07 31 13 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Metal flashing and trim.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Elastomeric flashing sealant.

- B. Samples: For each exposed product and for each color and blend specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

1.7 WARRANTY

- A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
1. Materials Warranty Period: 35 years from date of Substantial Completion, prorated, with first 15 years nonprorated.
 2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 80 mph for 15 years from date of Substantial Completion.
 3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 15 years from date of Substantial Completion.
 4. Workmanship Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.
- B. Energy Performance, ENERGY STAR: Provide asphalt shingles that are listed on the DOE's "ENERGY STAR Roof Product List" for steep-slope roof products.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Three-Tab-Strip Asphalt Shingles: ASTM D3462/D3462M; glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. GAF.
 - c. Owens Corning.
 2. Strip Size: Manufacturer's standard .
 3. Algae Resistance: Granules resist algae discoloration.
 4. Color and Blends: As selected by Architect from manufacturer's full range .
- B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles .

2.3 UNDERLAYMENT MATERIALS

- A. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance;

evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. GAF.
 - c. Owens Corning.

2.4 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Benjamin Obdyke Incorporated.
 - b. Certainteed; SAINT-GOBAIN.
 - c. Cor-A-Vent, Inc.
 - d. GAF.
 - e. Owens Corning.
 2. Minimum Net Free Area: 18 sq. inches per foot .
 3. Width: 11 1/2" .
 4. Thickness: 7/8 .
 5. Features:
 - a. Nonwoven geotextile filter strips.

2.5 ACCESSORIES

- A. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.
- B. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- diameter, sharp-pointed, with a 3/8- to 7/16-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.
 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch- minimum diameter.
 1. Provide with minimum 0.0134-inch- thick metal cap, 0.010-inch- thick power-driven metal cap, or 0.035-inch- thick plastic cap; and with minimum 0.083-inch- thick ring

shank or 0.091-inch- thick smooth shank of length to penetrate at least 3/4 inch into roof sheathing or to penetrate through roof sheathing less than 3/4 inch thick.

2.6 METAL FLASHING AND TRIM

- A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
 - 1. Sheet Metal: Stainless steel Anodized aluminum .
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise indicated on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT MATERIALS

- A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.
- B. Synthetic Underlayment:
 - 1. Install on roof deck parallel with and starting at the eaves.
 - a. Lap sides and ends as recommended in writing by manufacturer, but not less than 4 inches for side laps and 6 inches for end laps.
 - b. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer, but not less than 72 inches.
 - c. Fasten with underlayment nails in accordance with manufacturer's written instructions.
 - d. Cover underlayment within period recommended in writing by manufacturer.
 - 2. Install in single layer on roofs sloped at 4:12 and greater.
 - 3. Install in double layer on roofs sloped at less than 4:12.
 - 4. Install synthetic underlayment on roof deck not covered by self-adhering, polymer-modified bitumen sheet unless otherwise specified in this Section or indicated on Drawings.
 - a. Lap sides of underlayment over self-adhering sheet not less than 4 inches in direction to shed water.
 - b. Lap ends of underlayment not less than 6 inches over self-adhering sheet.
 - 5. Install fasteners in a grid pattern of 12 inches between side laps with 6-inch spacing at side and end laps.
 - 6. Terminate synthetic underlayment extended up not less than 4 inches against sidewalls, curbs, chimneys, and other roof projections.
- C. Metal-Flashed, Open-Valley Underlayment: Install two layers of minimum 36-inch- wide underlayment centered in valley.

1. Use same underlayment as installed on field of roof.
2. Stagger end laps between layers at least 72 inches.
3. Lap ends of each layer at least 12 inches in direction that sheds water, and seal with asphalt roofing cement.
4. Fasten each layer to roof deck with underlayment nails located as far from valley center as possible and only to extent necessary to hold underlayment in place until installation of valley flashing.
5. Lap roof-deck underlayment over first layer of valley underlayment at least 6 inches.

3.2 INSTALLATION OF METAL FLASHING AND TRIM

- A. Install metal flashings and trim to comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
 1. Install metal flashings in accordance with recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
 2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.
- B. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.3 INSTALLATION OF ASPHALT SHINGLES

- A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed at least 7 inches wide with self-sealing strip face up at roof edge.
 1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
 2. Install starter strip along rake edge.
- C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Install first and remaining courses of three-tab-strip asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- E. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
 1. Locate fasteners in accordance with manufacturer's written instructions.

2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 4. When ambient temperature during installation is below 50 deg F , hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
- F. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips.
1. Maintain uniform width of exposed open valley from highest to lowest point.
 2. Extend shingle a minimum of 4 inches over valley metal.
 3. Set valley edge of asphalt shingles in a 3-inch- wide bed of asphalt roofing cement.
 4. Do not nail asphalt shingles to metal open-valley flashings.
- G. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- H. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
1. Fasten with roofing nails of sufficient length to penetrate sheathing.
 2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 07 31 13

SECTION 07 46 33 - PLASTIC SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes vinyl siding and soffit.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For vinyl siding, include VSI's official certification logo printed on Product Data.
- B. Samples: For vinyl siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For vinyl siding Installer.
- B. Product certificates.
- C. Research/evaluation reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Vinyl Siding Installer Qualifications: A qualified installer who employs a VSI-certified Installer on Project.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 VINYL SIDING

- A. Vinyl Siding: Integrally colored product complying with ASTM D3679.

1. Basis-of-Design Product: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include but are not limited to the following:

- a. Gentek Building Products, Inc.
- b. Royal Building Products, a Westlake Company.
- c. Alside Exterior Building Products.

- B. Vinyl Siding Certification Program: Provide products that are listed in VSI's list of certified products.

- C. Horizontal Pattern: 6-1/2- or 7-inch exposure in beaded-edge, single-board style.

- D. Horizontal Pattern: 8-inch exposure in plain, style.

- E. Horizontal Pattern: 9-inch exposure in plain, board style.

- F. Horizontal Pattern: 10-inch exposure in double, 5-inch board style.

- G. Texture: Smooth .

- H. Nominal Thickness: 0.044 inch .

- I. Minimum Profile Depth (Butt Thickness): 3/4 inch .

- J. Nailing Hem: Double thickness.

2.2 VINYL SOFFIT

- A. Vinyl Soffit: Integrally colored product complying with ASTM D4477.

1. Basis-of-Design Product: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include but are not limited to the following:

- a. Alside Exterior Building Products.
- b. Gentek Building Products, Inc.
- c. Royal Building Products, a Westlake Company.

- B. Vinyl Siding Certification Program: Provide products that are listed in VSI's list of certified products.
- C. Pattern: 6-inch exposure in V-grooved, single-board style.
- D. Pattern: 12-inch exposure in V-grooved, board style.
- E. Texture: Smooth .
- F. Ventilation: Provide perforated soffit unless otherwise indicated.
- G. Nominal Thickness: 0.044 inch .
- H. Minimum Profile Depth: 3/4 inch .
- I. Colors: As selected by Architect from manufacturer's full range of colors .

2.3 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories made from same material as matching color and texture of adjacent siding unless otherwise indicated.
- B. Vinyl Accessories: Integrally colored vinyl accessories complying with ASTM D3679 except for wind-load resistance.
 - 1. Texture: Smooth .
- C. Colors for Decorative Accessories: As selected by Architect from manufacturer's full range of colors .
- D. Flashing: Provide aluminum flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
 - 1. Finish for Aluminum Flashing: Siliconized polyester coating, same color as siding .
- E. Fasteners:
 - 1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
 - 2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
 - 3. For fastening vinyl, use aluminum fasteners. Where fasteners are exposed to view, use prefinished aluminum fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.
- B. Install vinyl siding and soffit and related accessories in accordance with ASTM D4756.
 - 1. Install fasteners for horizontal vinyl siding no more than 16 inches o.c.
 - 2. Install fasteners for vertical vinyl siding no more than 12 inches o.c.
- C. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.2 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 33

SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fiber-cement siding and soffit.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For fiber-cement siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Research/evaluation reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie Building Products, Inc.; or comparable product by one of the following:
 - a. American Fiber Cement Corporation.
 - b. Certainteed; SAINT-GOBAIN.
 - c. GAF.
 - d. Nichiha USA, Inc.
 - e. James Hardie Building Products, Inc.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/16 inch.
- D. Horizontal Pattern: Boards 6-1/4 to 6-1/2 inches wide in plain style.
 - 1. Texture: Smooth .
- E. Shingle Pattern: 48-inch- wide, sheets with wood-grain texture.
- F. Panel Texture: 48-inch- wide sheets with smooth texture.
- G. Factory Priming: Manufacturer's standard acrylic primer.

2.2 FIBER-CEMENT SOFFIT

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie Building Products, Inc.; or comparable product by one of the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. Nichiha USA, Inc.
 - c. James Hardie Building Products, Inc.
- B. Nominal Thickness: Not less than 5/16 inch.
- C. Pattern: 12-inch- wide sheets with smooth texture.
- D. Factory Priming: Manufacturer's standard acrylic primer.

2.3 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
- B. Flashing: Provide aluminum flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
 - 1. Finish for Aluminum Flashing: Siliconized polyester coating .
- C. Fasteners:
 - 1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
 - 2. For fastening fiber cement, use hot-dip galvanized fasteners.
- D. Insect Screening for Soffit Vents: PVC-coated, glass-fiber fabric, 18-by-14 or 18-by-16 mesh .
- E. Continuous Soffit Vents: Aluminum, hat-channel shape.
 - 1. Net-Free Area: 9 sq. in./linear ft. .
 - 2. Finish: White paint Brown paint .

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.2 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 46

SECTION 07 54 23 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Roof insulation.
3. Cover board.
4. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Flashing details at penetrations.
3. Tapered insulation layout, thickness, and slopes.
4. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
6. Tie-in with adjoining air barrier.

C. Samples: For the following products:

1. Roof membrane and flashings, of color required.
2. Roof paver in each color and texture required.
3. Walkway pads or rolls, of color required.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
 1. Wind Uplift Load Capacity: 60 psf .
- D. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low -slope roof products.

- E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than and an emissivity of not less than 0.75 when tested according to CRRC-1.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Syntec Systems.
 - b. Firestone Building Products.
 - c. GAF.
 - d. GenFlex Roofing Systems.
 - e. Johns Manville; a Berkshire Hathaway company.
 - f. Versico Roofing Systems; Carlisle Construction Materials.
 - 2. Thickness: 60 mils , nominal.
 - 3. Exposed Face Color: White .

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 , felt or glass-fiber mat facer on both major surfaces.
 - 1. Size: 48 by 96 inches.
 - 2. Thickness:
 - a. Base Layer: 1-1/2 inches .

- b. Upper Layer: 1 1/2 inches .
- B. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation .
 - 2. Minimum Thickness: 1/4 inch.
 - 3. Slope:
 - a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- C. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch thick.
- D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
 - 1. Size: Approximately 36 by 60 inches.
 - 2. Color: Contrasting with roof membrane.
- B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged , factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hanover Architectural Products.
 - b. Wausau Tile, Inc.
 - c. Westile Roofing Products; Oldcastle APG, Inc.; CRH Americas, Inc.
 - 2. Size: 24 by 24 inches . Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch in length, height, and thickness.

3. Weight: 18 lb/sq. ft. .
4. Compressive Strength: 7500 psi , minimum.
5. Colors and Textures: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.
 - a. Test Frequency: One test probe per each 1000 sq. ft. , or portion thereof, of roof deck, with not less than three tests probes.
 - b. Submit test reports within 24 hours after performing tests.
 3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 1. Submit test result within 24 hours after performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.
- D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified.

3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Wood Decking:
 - 1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood panel decks.
 - a. Fasten slip sheet according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows .
 - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch with insulation.
 - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - g. Loosely lay base layer of insulation units over substrate.
 - 3. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood panel decks.
 - a. Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - b. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 4. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
 - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch with insulation.
 - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - h. Loosely lay each layer of insulation units over substrate.

- i. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
 - 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 4. Loosely lay cover board over substrate.
 5. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
 - b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- B. Install slip sheet over cover board and beneath roof membrane.

3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer, and install fabric-backed roof membrane. Do not apply to splice area of roof membrane.
- G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- I. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- J. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- K. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.7 INSTALLATION OF WALKWAYS

- A. Flexible Walkways:
 - 1. Install flexible walkways at the following locations:
 - a. Retain one or more subparagraphs below. Revise to suit Project.
 - b. Perimeter of each rooftop unit.
 - c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - e. Top and bottom of each roof access ladder.
 - f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - g. Locations indicated on Drawings.
 - h. As required by roof membrane manufacturer's warranty requirements.
 - 2. Provide 6-inch clearance between adjoining pads.
 - 3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

1. Install roof paver walkways at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - f. Locations indicated on Drawings.
 - g. As required by roof membrane manufacturer's warranty requirements.
2. Provide 3 inches of space between adjacent roof pavers.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed steep-slope roof sheet metal fabrications.
5. Formed wall sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested .
- B. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested , shop shall be listed as able to fabricate required details as tested and approved.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

07 62 00 - 2

weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

- B. Sheet Metal Standard for Flashing and Trim: Comply with and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces .

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: As selected by Architect from manufacturer's full range .
 - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304 , dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: .
- D. Lead Sheet: ASTM B749 lead sheet.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ATAS International, Inc.
 - b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - c. Henry Company.
 - d. Owens Corning.
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners , solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
 4. Fasteners for Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Solder:
 1. For Stainless Steel: ASTM B32, Grade Sn60 , with acid flux of type recommended by stainless steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polysulfide silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

- G. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions .
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corporation.
 - b. Hohmann & Barnard, Inc.
 2. Material: Stainless steel, 0.0188 inch thick Aluminum, 0.024 inch thick .
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 7. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 8. Finish: Mill .

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- G. Seams:
 1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
 3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters:
 1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
 2. Fabricate in minimum 96-inch- long sections.
 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness .
 4. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 5. Accessories: Valley baffles.
 6. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 - a. Aluminum: 0.032 inch thick.
 7. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:
 - a. Aluminum: 0.040 inch thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors . Shop fabricate elbows.

1. Fabricate from the following materials:
 - a. Aluminum: 0.024 inch thick.
- C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.
 1. Fabricate from the following materials:
 - a. Aluminum: 0.050 inch thick.
- B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
 1. Fabricate from the following materials:
 - a. Aluminum: 0.050 inch thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Aluminum: 0.040 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.
- E. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Stainless Steel: 0.0188 inch thick.
- F. Roof-Drain Flashing: Fabricate from the following materials:
 1. Stainless Steel: 0.0156 inch thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
 1. Aluminum: 0.032 inch thick.

- B. Valley Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.0188 inch thick.
- C. Drip Edges: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
- D. Eave, Rake , Ridge, and Hip Flashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.0156 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.0156 inch thick.
- C. Wall Expansion-Joint Cover: Fabricate from the following materials:
 - 1. Stainless Steel: 0.0188 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
 - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
 - 2. Prime substrate if recommended by underlayment manufacturer.
 - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
 - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
 - 5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
 - 6. Roll laps and edges with roller.
 - 7. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder or sealant.
 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
 6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 8. Do not field cut sheet metal flashing and trim by torch.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws .
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch into sealant.

- b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
- 1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
 - 2. Do not solder metallic-coated steel and aluminum sheet.
 - 3. Do not pretin zinc-tin alloy-coated copper.
 - 4. Do not use torches for soldering.
 - 5. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 - 6. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 - 7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
- 1. Join sections with riveted and soldered joints or joints sealed with sealant.
 - 2. Provide for thermal expansion.
 - 3. Attach gutters at eave or fascia to firmly anchor them in position.
 - 4. Provide end closures and seal watertight with sealant.
 - 5. Slope to downspouts.
 - 6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts:
- 1. Join sections with 1-1/2-inch telescoping joints.
 - 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
 - 3. Locate hangers at top and bottom and at approximately 60 inches o.c.
 - 4. Provide elbows at base of downspout to direct water away from building.
 - 5. Connect downspouts to underground drainage system.

D. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

E. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper or gutter discharge.

F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements , sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
 - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
 - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
 - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
 - 2. Extend counterflashing 4 inches over base flashing.
 - 3. Lap counterflashing joints minimum of 4 inches.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.
- C. Reglets: Installation of reglets is specified in Section 03 30 00 "Cast-in-Place Concrete." Section 04 20 00 "Unit Masonry."

3.6 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.8 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copings.
 - 2. Roof-edge specialties.
 - 3. Roof-edge drainage systems.
 - 4. Reglets and counterflashings.
- B. Preinstallation Conference: Conduct conference at Project site .

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roof specialties.
 - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
- C. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

1.6 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 073113 " Asphalt Roofing Asphalt Shingles ."

- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. SPRI Wind Design Standard: Manufacture and install copings roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
 - 1. Design Pressure: As indicated on Drawings .
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F , ambient; 180 deg F , material surfaces.

2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet , concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Architectural Products Company.
 - b. ATAS International, Inc.
 - c. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
 - 2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.050 inch thick .
 - a. Surface: Smooth, flat finish.
 - b. Finish: Three-coat fluoropolymer .
 - c. Color: As selected by Architect from manufacturer's full range .
 - 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
 - 4. Coping-Cap Attachment Method: Snap-on , fabricated from coping-cap material.
 - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.

2.3 ROOF-EDGE SPECIALTIES

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ATAS International, Inc.
 - b. EXCEPTIONAL Metals.
 - c. Metal-Era, Inc.
 2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.050 inch thick .
 - a. Surface: Smooth, flat finish.
 - b. Finish: Three-coat fluoropolymer .
 - c. Color: As selected by Architect from manufacturer's full range .
 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
 4. Splice Plates: Concealed , of same material, finish, and shape as fascia cover.
 5. Receiver: Aluminum sheet, 0.050 inch thick .
 6. Fascia Accessories: Wall cap Overflow scuppers .

2.4 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ATAS International, Inc.
 2. Castle Metal Products.
 3. Drexel Metals.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet , with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Aluminum Sheet: 0.050 inch thick.
 2. Gutter Profile: Style I according to SMACNA's "Architectural Sheet Metal Manual."
 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
 4. Gutter Supports: Gutter brackets with finish matching the gutters.
 5. Gutter Accessories: Flat ends .
- C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.050 inch thick.
- D. Zinc-Coated Steel Finish: Three-coat fluoropolymer .
1. Color: As selected by Architect from manufacturer's full range .

- E. Aluminum Finish: Three-coat fluoropolymer .
 - 1. Color: As selected by Architect from manufacturer's full range .
- F. Copper Finish: .

2.5 REGLETS AND COUNTERFLASHINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ATAS International, Inc.
 - 2. Castle Metal Products.
 - 3. Fry Reglet Corporation.
 - 4. Keystone Flashing Company, Inc.
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
 - 1. Formed Aluminum: 0.050 inch thick.
 - 2. Corners: Factory mitered and mechanically clinched and sealed watertight.
 - 3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
 - 1. Formed Aluminum: 0.032 inch thick.
- D. Accessories:
 - 1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
- E. Aluminum Finish: Three-coat fluoropolymer .
 - 1. Color: As selected by Architect from manufacturer's full range .

2.6 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

- D. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.7 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ATAS International, Inc.
 - b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - c. Henry Company.
 - d. Owens Corning.
 - e. Polyglass U.S.A., Inc.
 - f. Protecto Wrap Company.
 2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.
 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.

2.8 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

2.9 FINISHES

- A. Coil-Coated Aluminum Sheet Finishes:
1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
1. Apply continuously under copings roof-edge specialties and reglets and counterflashings.
 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.2 INSTALLATION, GENERAL

- A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 4. Torch cutting of roof specialties is not permitted.
 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws .

- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF COPING

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
 - 1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at 30-inch centers .
 - 2. Interlock face-leg drip edge into continuous cleat anchored to substrate at 16-inch centers . Anchor back leg of coping with screw fasteners and elastomeric washers at 16-inch centers .

3.4 INSTALLATION OF ROOF-EDGE SPECIALITIES

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 INSTALLATION OF ROOF-EDGE DRAINAGE-SYSTEM

- A. Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.

- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

- 1. Connect downspouts to underground drainage system indicated.

3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Embedded Reglets: See Section 03 30 00 "Cast-in-Place Concrete" and Section 04 20 00 "Unit Masonry" for installation of reglets.
- B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 07 71 00

SECTION 07 72 53 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pad-type, flat-mounted plastic snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Pad-Type Snow Guards: Full-size unit with installation hardware.
 - a. For units with factory-applied finishes, submit manufacturer's standard color selections .
2. Rail-Type Snow Guards: Bracket, 12-inch- long rail, and installation hardware.
 - a. For units with factory-applied finishes, submit manufacturer's standard color selections .

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces .

2.2 PAD-TYPE SNOW GUARDS

A. Pad-Type, Flat-Mounted Plastic Snow Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpine SnowGuards.
 - b. IceBlox Inc.
 - c. Levi's Building Components.
 - d. Polar Blox, Inc.
 - e. Zaleski Snow-Guards for Roofs, Inc.
2. Material: ASTM D6098 polycarbonate.
 - a. Color: As selected by Architect from manufacturer's full range .
3. Attachment: Manufacturer's tested system, capable of resisting design loads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on Shop Drawings.
2. Space rows as recommended by manufacturer.

B. Attachment for Asphalt Shingle Roofing:

1. Pad-Type, Flat-Mounted Snow Guards: Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles .

END OF SECTION 07 72 53

SECTION 07 76 00 - ROOF PAVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete roof paver units.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product and system indicated.

1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

B. Shop Drawings: For units and support system layout; indicate adjacent construction, perimeter containment components, penetrations, attachment details, and other conditions.

1. Include data indicating compliance with performance requirements.

C. Samples for Initial Selection: For each type of unit, provide representative charts of manufacturer's full range of patterns, textures, and colors.

D. Samples for Verification: For each type of exposed finish for each unit selected.

1. Unit Size: Manufacturers' standard size, 8 by 12 inches .
2. Accessories: base pad and shims.

E. Delegated Design Submittal: For pedestal support system and perimeter containment system installation, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For delegated design engineer.

B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units and pedestal support system to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Include inventory list of items delivered.
 - 1. Roof Slab Units: Full-size units in quantity equal to 5 percent of quantity installed for each type, pattern, color, and size.
 - 2. Roof Paver Units: Full-size units in quantity equal to 5 percent of quantity installed for each type, pattern, color, and size.
 - 3. Pedestal Supports: Units in quantity equal to 5 percent of quantity installed for each type and size. Include manufacturer-furnished adjustment tool.
 - 4. Deliver materials to location determined by Owner.

1.7 QUALITY ASSURANCE

- A. Delegated Design Engineer: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

1.8 MOCKUPS

- A. Mockup: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup in size and location indicated on Drawings, or if not indicated, no fewer than four units and nine pedestal supports .
 - 2. Acceptance of mockups does not constitute acceptance of deviations from the Contract Documents contained in mockups unless Architect specifically accepts such deviations in writing.
 - 3. Subject to compliance with requirements, accepted mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect products during shipping, handling, and storage to prevent staining, chipping, deterioration of components, or other damage. Store unused materials in original packaging.

2.1 ROOF PAVING UNITS

- A. Concrete Roof Slab Units: Complying with ASTM C1782/C1782M and resistant to freezing and thawing when tested in accordance with ASTM C1645/C1645M; made from normal-weight aggregates, molded- or extruded-concrete roof slab units, with integral color, and free of surface imperfections, intended for exterior use.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Unilock Group of Companies; Umbriano units or comparable product by one of the following:
 - a. Tile Tech, Inc.
 - b. Westile, Inc.
 2. Weight: 22 lb/sq. ft..
 3. Edge: Manufacturer's standard.
 4. Size: 23.6 by 23.6 inches .
 5. Thickness: 2 inches .
 6. Finish: Flamed-like face-mix .
 7. Colors and Textures: As selected by Architect from manufacturer's full range .
- B. Concrete Roof Paver Units: Complying with ASTM C936/C936M and resistant to freezing and thawing when tested in accordance with ASTM C1645/C1645M; made from normal-weight aggregates, molded- or extruded-concrete roof paver units, with integral color, and free of surface imperfections, intended for exterior use.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Unilock Group of Companies; As indicated by manufacturer's designations or comparable product by one of the following:
 - a. Tile Tech, Inc.
 - b. Westile, Inc.
 2. Weight: 33 lb/sq. ft. .
 3. Edge: Manufacturer's standard.
 4. Size: As indicated by manufacturer's designations .
 5. Thickness: 2.75 inches 4 inches .
 6. Finish: Smooth thru-mix .
 7. Colors and Textures: As selected by Architect from manufacturer's full range .

2.2 PEDESTAL SUPPORT SYSTEM

- A. Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane support components, including fixed-height or stackable pedestals, shims, spacer tabs, bases, extenders, reducers, bearing pads, and other accessories as necessary for a complete assembly.
1. Manufacturers and Products:
 - a. Bison Innovative Products; "Stackable Low Height Pedestal Supports."
 - b. Elmich; "VersiPave with Joiner Shims."
 2. Manufacturers and Products:
 - a. Bison Innovative Products; "Versadjust Deck Supports," "Level.It Adjustable Deck Supports," or "Bison ScrewJack (B-Series) Pedestal Systems."

PRODUCT MASTERSPEC LICENSED BY DELTEK, INC. TO UNILOCK GROUP OF COMPANIES

- b. Elmic; "VersiJack Pedestal System."
- 3. Allow for minimum 1/16 inch height adjustments.
- 4. Manufactured to withstand temperature extremes and reduce sound transmission.
- 5. Designed to maintain 1/8 to 3/16 inch unit joint width and alignment of units while allowing for drainage, air circulation, and prevention of water accumulation.
- 6. Load Capacity: Not less than 1500 lbf.

2.3 Other System Components, Provided by Installer

- A. Protection Course: As recommended by roofing membrane manufacturer to prevent damage to roofing while allowing adequate flow to drainage system.
- B. Perimeter Containment Components: System provided by Installer to restrain pedestal support system .

2.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design pedestal support system and perimeter containment system.
- B. Pedestal Support System: Capable of withstanding effects of gravity loads and the following loads and stresses, within limits and under conditions indicated:
 - 1. Roof Terraces: Uniform load of 125 lbf/sq. ft. or a concentrated load of 2000 lbf, whichever produces greater stress.
- C. Perimeter Containment System: Capable of resisting lateral forces in pedestal support system without displacement exceeding 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roofing membrane installation, with roofing Installer present, for protection from pedestal support system installation. Examine areas where roofing system is turned up or flashed against vertical surfaces and horizontal roofing.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install protection course over roofing membrane in accordance with roofing manufacturer's written instructions.

- B. Coordinate placement of pedestal support system with roofing membrane Work.

3.3 INSTALLATION, GENERAL

- A. Install systems and components in accordance with manufacturer's written instructions and accepted Shop Drawings.
- B. Mix units from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut units with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Joint Pattern: As indicated .
- E. Units over Roofing: Exercise care in placing units and setting materials over roofing so protection materials are not displaced and roofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged roofing before covering with units.

3.4 INSTALLATION OF PEDESTAL SUPPORT SYSTEM

- A. Lay out and mark pedestal support locations on top of protection course. Install bearing pads below pedestal supports.
- B. Adjust pedestal support heights prior to, and following, installation of units. Shim where fine adjustment is necessary using manufacturer-provided shims.

3.5 INSTALLATION OF ROOF SLAB AND PAVER UNITS

- A. Do not use units with chips, cracks, voids, discolorations, edge damage, and other defects that might be visible or cause staining in finished work.
- B. Install units over pedestal support system . Align joint patterns parallel in each direction.
 - 1. Lay out units to avoid less-than-half-width units at perimeter or other terminations.
- C. Set units in place using placement methods that result in stable installation free from rocking.
- D. Loosely set units, maintaining a uniform joint width. Align joint patterns parallel in each direction.
- E. Tightly seat units against spacers to eliminate lateral movement or drift of paving assembly. Make final in-place level adjustments using manufacturer's furnished tool to adjust paver support heights.

3.6 CONSTRUCTION TOLERANCES

- A. Variation of Level Across Width of Each Unit: 1/16 inch, maximum.
- B. Variation from Level: Do not exceed 1/4 inch in 10 ft., when measured at any location and in any direction.
- C. Variation in Joint Width: Do not vary joint thickness more than one-fourth of nominal joint width.
- D. Variation in Plane at Joints (Lipping): Do not exceed 1/16 inch difference between planes of adjacent units.
- E. Variation in Line of Edge at Joints (Lipping): Do not exceed 1/16 inch difference between edges of adjacent units, where edge line continues across joint.

3.7 CLEANING AND PROTECTION

- A. Remove and replace loose, chipped, broken, stained, or otherwise damaged units or units that do not match adjoining units or pattern indicated on Drawings.
- B. Cleaning: Remove soiling from exposed surfaces; wash and scrub clean. Leave joints between units open and clean of debris to allow for proper drainage and airflow.
- C. Provide final protection and maintain units without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 76 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:
 - a. Penetrations in fire-resistance-rated walls.
 - b. Penetrations in horizontal assemblies.
 - c. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

- ##### A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.

5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 13

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. ClarkDietrich.
 - c. Hilti, Inc.
 - d. Marino\WARE.
 - e. NUCO Inc.
 - f. Owens Corning.
 - g. ROCKWOOL.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. Marino\WARE.
 - d. NUCO Inc.
 - e. Owens Corning.
 - f. ROCKWOOL.
 - 2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- E. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product data.

B. Joint-sealant schedule.

C. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

1.6 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, undefined
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
- B. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. The Dow Chemical Company.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, undefined
 - a. Tremco Incorporated.
- C. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, undefined
 - a. The Dow Chemical Company.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. <Click here to find, evaluate, and insert list of manufacturers and products.>

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, undefined
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. The Dow Chemical Company.
 - c. Tremco Incorporated.

2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, undefined
 - a. Sherwin-Williams Company (The).
 - b. Tremco Incorporated.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Manufacturers: Subject to compliance with requirements, undefined
 - a. Construction Foam Products; a division of Nomaco, Inc.
 - b. Master Builders Solutions.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.

- d. .
- 3. Remove laitance and form-release agents from concrete.
- 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
 - e. .
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - 4. Provide flush joint profile at in accordance with Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at in accordance with Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- H. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
 - 2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
 - b. Test Method: Test joint sealants in accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.
 - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine

- if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
 - 2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- C. Prepare test and inspection reports.

3.4 JOINT-SEALANT SCHEDULE

- A. Exterior joints in horizontal traffic surfaces:
- 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints in stone paving units.
 - c. Tile control and expansion joints.
 - d. Joints between different materials listed above.
 - e. .
 - 2. Joint Sealant: Urethane, M, P, 50, T, NT .
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- B. Exterior joints in horizontal traffic surfaces subject to water immersion:
- 1. Joint Locations:
 - a. Joints in pedestrian plazas.
 - b. .
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I .
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- C. Exterior joints in vertical surfaces and horizontal nontraffic surfaces:
- 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in dimension stone cladding.
 - d. Joints in exterior insulation and finish systems.
 - e. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - g. Control and expansion joints in ceilings and other overhead surfaces.

- h. .
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT .
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- D. Interior joints in horizontal traffic surfaces:
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. .
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, P, 25, T, NT .
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- E. Interior joints in vertical surfaces and horizontal nontraffic surfaces:
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
 - c. .
 - d. .
 - e. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT .
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- F. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-#:
1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
 - c. .
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex .
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- G. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces:
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. .
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT .
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
- H. Concealed mastics:
1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. .

- d. Other joints as indicated on Drawings.
- 2. Joint Sealant: Butyl-rubber based .
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

END OF SECTION 07 92 00

SECTION 07 92 19 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical joint sealants.

1.2 ACTION SUBMITTALS

A. Product data.

B. Acoustical joint-sealant schedule.

C. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product test reports.

B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.5 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

- A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Hilti, Inc.
 - c. OSI Sealants; Henkel Corporation.
 - d. USG Corporation.
 - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors .

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

- B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

END OF SECTION 07 92 19

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. DCI Hollow Metal on Demand.
3. Gensteel Doors.
4. HMF Express.
5. JR Metal Frames, Inc.
6. MPI Group, LLC (The).
7. Republic Doors and Frames; a Allegion brand.
8. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. All interior locations where steel doors are specified .
 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 1, Full Flush .
 - e. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Full profile welded.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. All locations where Maximum-Duty Doors are not specified .
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless .
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Manufacturer's standard .
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - b. Construction: Full profile welded.
- C. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule .
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Manufacturer's standard .
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A60 coating.
 - b. Construction: Full profile welded.

2.5 FRAME ANCHORS

- A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.7 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 .
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 .
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

- C. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 12 13 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, and wall opening conditions.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Apex Industries, Inc.
 2. Ceco Door; AADG, Inc.; ASSA ABLOY.
 3. DCI Hollow Metal on Demand.
 4. DKS Steel Door & Frame Systems, Inc.
 5. JR Metal Frames, Inc.
 6. MPI Group, LLC (The).
 7. Republic Doors and Frames; a Allegion brand.
 8. Security Metal Products; a brand of ASSA ABLOY.

9. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Interior Frames: SDI A250.8. At locations indicated in the Door and Frame Schedule .
 1. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch .
 2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 3. Construction: Full profile welded.
 4. Exposed Finish: Prime .

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet .
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
 - 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: SDI A250.10.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11 .
- B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - 1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - 2. Install frames with removable stops located on secure side of opening.
- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Floor Anchors: Secure with postinstalled expansion anchors.
 - 1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- E. Solidly pack mineral-fiber insulation inside frames.
- F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
- G. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors.
- H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch , measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch , measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch , measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch , measured at jambs at floor.
- I. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.2 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 12 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood doors for opaque finish.
2. Hollow-core flush wood doors for opaque finish.
3. Factory flush wood doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory- priming specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Apply AWI Quality Certification Program label to Shop Drawings.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program .

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with "Architectural Woodwork Standards."
 - 1. Provide labels and certificates from AWI certification program indicating that doors and frames comply with requirements of grades specified.
 - a. Contractor registers the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.

2.3 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

- A. Interior Doors, Solid-Core Five-Ply SCW :
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Masonite Architectural.
 - b. Oshkosh Door Company.
 - c. VT Industries, Inc.
 - 2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty .
 - 3. Performance Grade by Location:
 - a. ANSI/WDMA I.S. 1A Extra Heavy Duty: public toilets janitor's closets assembly spaces exits and and where indicated on Drawings.

- b. ANSI/WDMA I.S. 1A Standard Duty: Inside residential units. and where indicated on Drawings.
- 4. Architectural Woodwork Standards Grade: Premium .
- 5. Faces: Any closed-grain hardwood of mill option .
 - a. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
 - b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.
- 6. Exposed Vertical Edges: Any closed-grain hardwood.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors:
 - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
- 7. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-2 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a) 5-inch top-rail blocking, in doors indicated to have closers.
 - b) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c) 5-inch midrail blocking, in doors indicated to have exit devices.
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Face: 550 lbf .
 - 2) Screw Withdrawal, Edge: 550 lbf .
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
- 8. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
 - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:
 - 1) 5-inch top-rail blocking.
 - 2) 5-inch bottom-rail blocking, in doors indicated to have protection plates.
 - 3) 5-inch midrail blocking, in doors indicated to have armor plates.
 - 4) 5-inch midrail blocking, in doors indicated to have exit devices.
- 9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 HOLLOW-CORE FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Doors, Hollow Core :

- 1. Basis-of-Design Product: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include but are not limited to the following:

- a. Haley Brothers, Inc.
- b. Vancouver Door Company.
- c. ABS- American Building Supply- Doormerica.
2. Performance Grade: ANSI/WDMA I.S. 1A Standard Duty.
3. Architectural Woodwork Standards Grade: Premium .
4. Faces: Any closed-grain hardwood of mill option .
 - a. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
 - b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.
5. Exposed Vertical and Top Edges: Any closed-grain hardwood.
6. Construction: Institutional hollow core.
7. Blocking: Provide wood blocking with minimum dimensions as follows:
 - a. 5-by-18-inch lock blocks at both stiles.
 - b. 5-inch top- and bottom-rail blocking.
 - c. 10-inch top- and bottom-rail blocking.
 - d. 2-1/2-inch midrail blocking.

2.5 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Species compatible with door faces .
 2. Profile: Flush rectangular beads .
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."
 3. Louvers: Factory install louvers in prepared openings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."

- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - C. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
 - 3. Install fire-rated doors and frames in accordance with NFPA 80.
 - 4. Install smoke- and draft-control doors in accordance with NFPA 105.
 - D. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 - 2. Machine doors for hardware.
 - 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - d. Comply with NFPA 80 for fire-rated doors.
 - 5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
 - E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
 - F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- 3.2 ADJUSTING
- A. Operation: Rehang or replace doors that do not swing or operate freely.
 - B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.
2. Fire-rated access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - d. Larsen's Manufacturing Company.

- e. MIFAB, Inc.
 - f. Milcor; Hart & Cooley, Inc.
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Optional Features: Gasketing.
4. Locations: Wall and ceiling.
5. Uncoated Steel Sheet for Door: Nominal 0.060 inch , 16 gage , factory primed .
6. Frame Material: Same material and thickness as door .
7. Latch and Lock: Latch bolt, key operated with interior release.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - d. MIFAB, Inc.
 - e. Milcor; Hart & Cooley, Inc.
2. Description: Door face flush with frame, uninsulated; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
3. Optional Features: Gasketing.
4. Locations: Wall and ceiling.
5. Fire-Resistance Rating: Not less than that of adjacent construction. Doors in 2-hour walls may be 90-minute rated.
6. Uncoated Steel Sheet for Door: Nominal 0.036 inch , 20 gage , factory primed .
7. Frame Material: Same material, thickness, and finish as door .
8. Latch and Lock: Self-closing, self-latching door hardware, operated by key , with interior release.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- C. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.
 - 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 08 71 00 "Door Hardware."

2.6 FINISHES

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
 - a. Color: As selected by Architect from full range of industry colors .

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

- C. Samples: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

- B. Product test reports.

- C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Qualifications:

1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.
 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings .
- C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches .

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 3. Cantilever Deflection: Limited to $2L/175$ at unsupported cantilevers.
- D. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. .
- F. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 2. Solar Heat-Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.40 as determined in accordance with NFRC 200.
 - b. Entrance Doors: SHGC of not more than 0.40 as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
 - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 4. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
 - b. Entrance Doors: CRF of not less than 63 as determined in accordance with AAMA 1503.

2.2 STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kawneer Company, Inc.; Arconic Corporation.
 2. Trulite Glass & Aluminum Solutions, LLC.
 3. Tubelite Inc.
 4. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.
 5. YKK AP America Inc.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken .
 2. Interior Vestibule Framing Construction: Nonthermal .
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Finish: .
 5. Fabrication Method: Field-fabricated stick system.
 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 7. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Kawneer Company, Inc.; Arconic Corporation.
 2. Trulite Glass & Aluminum Solutions, LLC.
 3. Tubelite Inc.
 4. YKK AP America Inc.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior .
 2. Door Design: Wide stile; 5-inch nominal width .

3. Glazing Stops and Gaskets: Square , snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.
 1. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 2. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- B. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. Continuous-Gear Hinges: BHMA A156.26.
- D. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
- E. Cylinders:
 1. As specified in Section 08 71 00 "Door Hardware."
 2. BHMA A156.5, Grade 1.
 - a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" .
- F. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- G. Operating Trim: BHMA A156.6.
- H. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

- I. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- J. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- K. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- L. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.5 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.6 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
 - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

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- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior .
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color and Gloss: As indicated by manufacturer's designations As selected by Architect from manufacturer's full range .

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.

- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 08 80 00 "Glazing."

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION 08 41 13

SECTION 08 54 13 - FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. A.Fiberglass windows.

1.2 RELATED SECTIONS

- A. A.Section 07 27 00 - Air Barriers: Water-resistant barrier.
- B. B.Section 07 92 00 - Joint Sealants: Sealants and caulking.

1.3 REFERENCES

- A. A.American Architectural Manufacturers Association (AAMA):

- 1. 1. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Doors.
- 2. 2. AAMA 624-10 - Voluntary Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles.

- B. B.American Society for Testing and Materials (ASTM):

- 1. 1. ASTM C 1036 - Flat Glass.
- 2. 2. ASTM C 1048 - Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
- 3. 3. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
- 4. 4. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- 5. 5. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.
- 6. 6. ASTM E 1105 – Standard Test Method for Field Determination of Water Penetration of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- 7. ASTM F 2090 – Standard Specification for Window Fall Prevention Devices With Emergency Escape (Egress) Release Mechanisms
- 8. C. Window and Door Manufacturers Association (WDMA):
- 9. 1. ANSI/AAMA/NWDA 101/I.S.2 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
- 10. Screen Manufacturers Association (SMA):
- 11. SMA 1201 – Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.

12. Window and Door Manufacturers Association (WDMA):
13. AAMA/WDMA/CSA 101/I.S.2/A440 – North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

1.4 1.4 PERFORMANCE REQUIREMENTS

- A. Windows shall meet a rating of LC-PG 30 specifications in accordance with ANSI/AAMA/WDMA 101/I.S.2/A440-17.
- B. B.Window Air Leakage, ASTM E 283: Window air leakage when tested at 1.57 psf (25 mph) shall be 0.05 cfm/ft² of frame or less.
 1. C. Window Water Penetration, ASTM E 547: No water penetration through window when tested under static pressure of 7.5 psf (42 mph) after 4 cycles of 5 minutes each, with water being applied at a rate of 5 gallons per hour per square foot.

1.5 1.5 SUBMITTALS

- A. A.Submit in accordance with Division 1 requirements.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, indicating dimensions, construction, component connections and locations, anchorage methods and locations, hardware locations, and installation details.
- D. Samples: Submit full-size or partial full-size sample of window illustrating glazing system, quality of construction, and color of finish.
- E. Warranty:
 1. Manufacturer agrees to repair or replace fiberglass windows that fail in materials or workmanship within specified warranty period.
 2. Failures include, but are not limited to, the following:
 3. Failure to meet performance requirements.
 4. Structural failures including excessive deflection, water leakage, and air infiltration.
 5. Faulty operation of movable sash and hardware.
 6. Deterioration of materials and finishes beyond normal weathering.
 7. Failure of insulating glass.
 8. Warranty Period:
 9. Window: 10 years from date of Substantial Completion.
 10. Glazing Units, Nonlaminated: 20 years from date of Substantial Completion.
 11. 2 years of free service labor

1.6 1.6 QUALITY ASSURANCE

- A. A.Mockup:

1. 1. Provide sample installation for field testing window performance requirements and to determine acceptability of window installation methods.
2. 2. Approved mockup shall represent minimum quality required for the Work.
3. 3. Approved mockup shall remain in place within the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. A.Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.
- B. B.Storage:
 1. 1. Store materials in accordance with manufacturer's instructions.
 2. 2. Store materials off ground and under cover.
 3. 3. Protect materials from weather, direct sunlight, and construction activities.
- C. C.Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 - PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design - Pella Corporation, 102 Main Street, Pella, Iowa 50219.
- B. Local Representative: Pia Naiditch, Phone (412) 529-0003
- C. Alternate fiberglass manufacturers as submitted and approved by the architect.
- D. Substitutions: Only products approved by the architect will be acceptable. Submit the following listed items (2-5) with proper documentation as required for substitution requests. Allow an additional (15) working days for any substitution review in addition to the standard review time for submittals.
 1. Request for substitutions must follow the requirements in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.
 2. Independent test reports certifying that proposed product is in accordance with, and meets all criteria specified in Section 1.4 "PERFORMANCE REQUIREMENTS".
 3. Drawing details of elevations and sections, and samples in accordance with, and specified in Section 1.5 "SUBMITTALS".
 4. Copy of manufacturer's warranty specified in accordance with, and as specified in Section 1.5 "SUBMITTALS: Warranty".
 5. Any additional information requested by the Architect.

2.2 FIBERGLASS WINDOWS

- A. Windows: Pella Impervia.

1. 1. Factory-assembled fiberglass double hung windows with interior tilting sash, sliding window.
2. 2. Frame and Sash Material: 5-layer, pultruded-fiberglass material, reinforced with interlocking mat.

B. Frame:

1. Type: Block frame.
2. Interior and Exterior Frame: Pultruded, fiberglass composite.
3. Overall Frame Depth: 3 inches.
4. Nominal Wall Thickness of Fiberglass Members: 0.050 inch to 0.090 inch.
5. Frame Corners:
 - a. Mitered.
 - b. Joined and bonded with Neutral-cure Room Temperature Vulcanizing silicone hot-melt adhesive, with corner lock.
6. Jambs: Contain factory-drilled installation screw holes.

C. Sash:

1. Sash Corners:
 - a. a. Mitered.
 - b. b. Bonded and sealed with injected Neutral-cure Room Temperature Vulcanizing silicone hot-melt adhesive.

D. D.Glazing:

1. 1. Float Glass: ASTM C 1036, Quality 1.
2. a. Tempered Glass (where required as indicated on drawings): ASTM C 1048.
3. Type: Polyurethane reactive (PUR) hot-melt glazed, 11/16-inch thick, insulating glass, clear (tempered and or obscured tempered where required), multi-layer Low-E coated with argon.

E. OPTIONS

1. A. Insect Screens:
 - a. 1. Compliance: ASTM D 3656 and SMA 1201.
 - b. 2. Screen Cloth: Black Vinyl-coated fiberglass, 18/16 mesh.
 - c. 3. Set in aluminum frame.
 - d. 4. Complete with necessary hardware.
 - e. 5. Screen Frame Finish: Baked enamel.
 - 1) a. Color: match window frame color.

2.3 HARDWARE

A. Hung

B. Balances: Galvanized steel block-and-tackle balances.

C. Lock:

1. Type: Self-aligning, cam-action lock.
2. Windows 37 Inches Wide or Greater: 2 locks.
3. Finish: Match window interior finish.

D. Tilt Latches:

1. Glass reinforced Nylon 6
2. Integrated into sash corner
3. Finish is matte gray

E. Lower Sash Lift: Integrated into checkrail. Include optional sash lift applied to lower portion of sash in rooms with ADA Accessibility reach requirements

F. Window Limiters: All units to have factory installed concealed sash limiting devices

G. Include optional pull cord release locks in rooms with ADA Accessibility reach requirements.

2.4 TOLERANCES

A. A.Windows shall accommodate the following opening tolerances:

1. 1. Vertical Dimensions Between High and Low Points: Plus 1/4-inch, minus 0 inch.
2. 2. Width Dimensions: Plus 1/4-inch, minus 0 inch.
3. 3. Building Columns or Masonry Openings: Plus or minus 1/4-inch from plumb.

2.5 FINISH

A. A.Exterior and Interior Finish: Factory-applied powder-coat paint, comply with AAMA 624-10.

B. Color: White interior and exterior

2.6 INSTALLATION ACCESSORIES

A. Flashing/Sealant Tape: Pella SmartFlash.

B. Aluminum-foil-backed butyl window and door flashing tape.

C. Maximum Total Thickness: 0.013 inch.

D. UV resistant.

E. Verify sealant compatibility with sealant manufacturer.

F. Interior Insulating-Foam Sealant: Low-expansion, low-pressure polyurethane insulating

G. window and door foam sealant.

H. Exterior Perimeter Sealant: "Pella Window and Door Installation Sealant" or equivalent high quality, multi-purpose sealant as specified in the joints sealant section.

- I. Block Frame Installation Accessories: Installation clips.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. A.Examine areas to receive windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. A.Install windows in accordance with manufacturer's instructions.
- B. B.Install windows to be weather-tight.
- C. C.Maintain alignment with adjacent work.
- D. D.Secure assembly to framed openings, plumb and square, without distortion.
- E. E.Integrate window system installation with exterior water-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with water-resistant barrier using watershed principles in accordance with window manufacturer's instructions.
- F. F. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using insulating foam sealant.
- G. G.Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.

3.3 CLEANING

- A. A.Clean window frames and glass in accordance with Division 1 requirements.
- B. B.Do not use harsh cleaning materials or methods that would damage finish or glass.
- C. C.Remove labels and visible markings.

3.4 PROTECTION

- A. A.Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

END OF SECTION 08 54 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .
- B. Keying Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For electrified door hardware.
1. Include diagrams for power, signal, and control wiring.
 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and

extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC) .

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Electromagnetic Locks: Five years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.
 - c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" ICC A117.1 HUD's "Fair Housing Accessibility Guidelines" and UFAS .

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Baldwin; part of the Spectrum Brands Hardware and Home Improvement Group (HHI).
 - c. Hager Companies.
 - d. INOX; Unison Hardware, Inc.
 - e. Lawrence Hardware Inc.

- f. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
- g. PBB, Inc.
- h. STANLEY; dormakaba USA, Inc.

2.3 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Hager Companies.
 - c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - d. PBB, Inc.
 - e. STANLEY; dormakaba USA, Inc.

2.4 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Architectural Builders Hardware Mfg., Inc.
 - c. Hager Companies.
 - d. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - e. PBB, Inc.
 - f. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - g. STANLEY; dormakaba USA, Inc.
 - h. Zero International; Allegion plc.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 3. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Lock Trim:
1. Description: As selected by Architect from Manufacturer's full range of trim options.
 2. Levers: Cast.
 3. As selected by Architect from Manufacturer's full range of trim options.
 4. Escutcheons (Roses): Cast.
 5. Dummy Trim: Match lever lock trim and escutcheons. For dummy trim, provide back mounting plate. Hardware shall attach the dummy trim to the backing plate through the door.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
- F. Bored Locks: BHMA A156.2; Grade 1 ; Series 4000.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - d. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - e. dormakaba USA Inc.
 - f. Hager Companies.
 - g. INOX; Unison Hardware, Inc.
 - h. Lawrence Hardware Inc.
 - i. Marks USA; Napco Security Technologies, Inc.
 - j. PDQ Industries, Inc.
 - k. SARGENT Manufacturing Company; ASSA ABLOY.
 - l. SOSS Door Hardware; Universal Industrial Products, Inc.
 - m. STANLEY; dormakaba USA, Inc.
 - n. Weiser; part of the Spectrum Brands Hardware and Home Improvement Group (HHI).
 - o. Yale Security Inc; ASSA ABLOY.

2.6 AUXILIARY LOCKS

- A. Bored Auxiliary Locks: BHMA A156.36: Grade 1 ; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - d. Hager Companies.
 - e. INOX; Unison Hardware, Inc.
 - f. Lawrence Hardware Inc.
 - g. Marks USA; Napco Security Technologies, Inc.
 - h. Medeco Security Locks; an ASSA ABLOY Group company.
 - i. PDQ Industries, Inc.
 - j. SARGENT Manufacturing Company; ASSA ABLOY.
 - k. STANLEY; dormakaba USA, Inc.
 - l. Weiser; part of the Spectrum Brands Hardware and Home Improvement Group (HHI).
 - m. Yale Security Inc; ASSA ABLOY.

2.7 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1 ; with faceplate to suit lock and frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Adams Rite Manufacturing Company, an ASSA ABLOY Group company.
 - b. Allegion plc.
 - c. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
 - d. Hager Companies.
 - e. Hanchett Entry Systems (HES), Inc.; ASSA ABLOY Group.
 - f. PDQ Industries, Inc.
 - g. Security Door Controls.
 - h. STANLEY; dormakaba USA, Inc.
 - i. Trine Access Technology.

2.8 SELF-CONTAINED ELECTRONIC LOCKS

- A. Self-Contained Electronic Locks: BHMA A156.25, bored ; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - c. Kaba Ilco Corp.

- d. Marks USA; Napco Security Technologies, Inc.
- e. SARGENT Manufacturing Company; ASSA ABLOY.
- f. Yale Security Inc; ASSA ABLOY.

2.9 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Adams Rite Manufacturing Company, an ASSA ABLOY Group company.
 - b. Allegion plc.
 - c. Door Controls International.
 - d. INOX; Unison Hardware, Inc.
 - e. Trimco.

2.10 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic Flush Bolts: BHMA A156.3, Type 25; minimum 3/4-inch throw; with dust-proof strikes; designed for mortising into door edge. Include wear plates.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Door Controls International.
 - c. Trimco.

2.11 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Adams Rite Manufacturing Company, an ASSA ABLOY Group company.
 - b. Allegion plc.
 - c. Arrow USA; an ASSA ABLOY Group company.
 - d. C.R. Laurence Co., Inc.; CRH Americas, Inc.
 - e. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - f. Door Controls International.
 - g. dormakaba USA Inc.
 - h. Hager Companies.
 - i. INOX; Unison Hardware, Inc.
 - j. Lawrence Hardware Inc.
 - k. Precision Hardware, Inc.; dormakaba Group.

- l. SARGENT Manufacturing Company; ASSA ABLOY.
- m. STANLEY; dormakaba USA, Inc.
- n. Yale Security Inc; ASSA ABLOY.

2.12 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
- B. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.
 - 1. Type: M, mechanical .
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.13 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 - 2. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Brass.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."

2.14 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. American Key Boxes and Cabinets.
 - b. HPC, a Hudson Lock Company.
 - c. Interlogix; Carrier Global Corporation.
 - d. MMF Industries.
 - e. TelKee; Oasis International.

2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.15 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Allegion plc.
 - b. Hager Companies.
 - c. INOX; Unison Hardware, Inc.
 - d. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - e. Trimco.

2.16 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.17 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - d. dormakaba USA Inc.
 - e. Hager Companies.
 - f. INOX; Unison Hardware, Inc.
 - g. Norton Door Controls; ASSA ABLOY.
 - h. SARGENT Manufacturing Company; ASSA ABLOY.
 - i. STANLEY; dormakaba USA, Inc.

- j. Yale Security Inc; ASSA ABLOY.

2.18 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. American Specialties, Inc. (ASI).
 - c. Architectural Builders Hardware Mfg., Inc.
 - d. Baldwin; part of the Spectrum Brands Hardware and Home Improvement Group (HHI).
 - e. Door Controls International.
 - f. Hager Companies.
 - g. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - h. Trimco.

2.19 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Hager Companies.
 - b. National Guard Products, Inc.
 - c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - d. Zero International; Allegion plc.

B. Provide gasketing on all doors except doors internal to residential units.

C. Maximum Air Leakage: When tested in accordance with ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:

- 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
- 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
- 3. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.

2.20 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Hager Companies.
 - b. National Guard Products, Inc.
 - c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - d. Zero International; Allegion plc.

2.21 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Hager Companies.
 - c. INOX; Unison Hardware, Inc.
 - d. inpro Corporation.
 - e. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - f. Trimco.

2.22 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.
 - b. Baldwin; part of the Spectrum Brands Hardware and Home Improvement Group (HHI).
 - c. Hager Companies.
 - d. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
 - e. Trimco.

2.23 AUXILIARY ELECTRIFIED DOOR HARDWARE

- A. Auxiliary Electrified Door Hardware:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Allegion plc.

- b. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
- c. Door Controls International.
- d. dormakaba USA Inc.
- e. Hager Companies.
- f. Interlogix; Carrier Global Corporation.
- g. PDQ Industries, Inc.
- h. Precision Hardware, Inc.; dormakaba Group.
- i. SARGENT Manufacturing Company; ASSA ABLOY.
- j. Security Door Controls.

2.24 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- E. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

- A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Miscellaneous glazing materials.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product test reports.

1.5 QUALITY ASSURANCE

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or

to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 1. Design Wind Pressures: As indicated on Drawings.
 2. Design Snow Loads: As indicated on Drawings.
 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGC Glass Company North America, Inc.
 - b. Vitro Architectural Glass.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cardinal Glass Industries, Inc.
 - b. Vitro Architectural Glass.

2.4 LAMINATED GLASS

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Saflex; Eastman.
 2. Construction: Laminate glass with polyvinyl butyral interlayer ionoplast interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
 3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 4. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
1. Sealing System: Dual seal, with manufacturer's standard polyisobutylene and polysulfide polyisobutylene and silicone polyisobutylene and hot-melt butyl polyisobutylene and polyurethane primary and secondary sealants.
 2. Perimeter Spacer: Manufacturer's standard spacer material and construction Thermally broken aluminum Nonmetallic laminate or Silicone with integral desiccant and vapor barrier.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Technoform Glass Insulation North America.
 - 2) Thermix; a brand of Ensinger USA.
 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:
1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
 2. Type recommended in writing by sealant or glass manufacturer.
- C. Spacers:
1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 2. Type recommended in writing by sealant or glass manufacturer.

- D. Edge Blocks:
 - 1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

3.2 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners

and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.3 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.4 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type : Annealed Fully tempered float glass.
 - 1. Minimum Thickness: 6 mm .
 - 2. Safety glazing required.

3.5 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Clear Insulating Glass Type :
 - 1. Overall Unit Thickness: 1 inch .
 - 2. Minimum Thickness of Each Glass Lite: 6 mm .
 - 3. Outdoor Lite: Annealed Fully tempered float glass.
 - 4. Interspace Content: Air .
 - 5. Indoor Lite: Annealed or as required, Fully tempered float glass.
 - 6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
 - 7. Safety glazing required.

3.6 INSULATING-LAMINATED-GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Laminated Glass Type :

1. Overall Unit Thickness: 1 inch <Insert dimension>.
2. Minimum Thickness of Outdoor Lite: 5 mm 6 mm <Insert thickness>.
3. Outdoor Lite: Clear fully tempered float glass.
4. Interspace Content: Air .
5. Indoor Lite: Clear laminated glass with two plies of annealed fully tempered float glass.
 - a. Minimum Thickness of Each Glass Ply: 6 mm .
 - b. Interlayer Thickness: 0.060 inch .
6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
7. Safety glazing required.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silvered flat glass mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion .

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Guardian Glass LLC.
 2. National Glass Industries, Inc.
 3. Sunshine Mirror.
 4. Trulite Glass & Aluminum Solutions, LLC.
 5. Walker Glass Co., Ltd.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C1503.
- B. Annealed Monolithic Glass Mirrors: Mirror Quality, clear .
1. Nominal Thickness: 4.0 mm .
- C. Safety Glazing Products: For film-backed mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. C.R. Laurence Co., Inc.; CRH Americas, Inc.
 - b. Franklin International.
 - c. Liquid Nails; PPG Industries, Inc.
 - d. OSI Sealants; Henkel Corporation.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
- 1. Aluminum J-Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - 2. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.5 FABRICATION

- A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.
- B. Mirror Edge Treatment: Flat polished .
- 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
- C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
 - 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.
- C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 08 83 00

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated on Drawings .

B. Gypsum Shaftliner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Gypsum.
 - 2) National Gypsum Company.
 - 3) USG Corporation.
 - b. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) American Gypsum.
 - 2) National Gypsum Company.
 - 3) USG Corporation.

- C. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

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- D. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
 - 1. Depth: As indicated .
 - 2. Minimum Base-Metal Thickness: As indicated .
- E. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: As indicated .
- F. Finish Panels: Gypsum board as specified in Section 09 29 00 "Gypsum Board." .

2.3 AUXILIARY MATERIALS

- A. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- B. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged.
- D. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- E. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- F. Penetrations: Install supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

- G. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.
- I. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 09 21 16.23

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Gypsum board, Type X.
2. Gypsum ceiling board.
3. Mold-resistant gypsum board.
4. Gypsum board, Type C.
5. Glass-mat, water-resistant backing board.
6. Interior trim.
7. Joint treatment materials.
8. Sound-attenuation blankets.
9. Acoustical sealant.

B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Certainteed; SAINT-GOBAIN.
 - c. National Gypsum Company.
 - d. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered .

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. Certainteed; SAINT-GOBAIN.
 - c. National Gypsum Company.
2. Thickness: 1/2 inch.
3. Long Edges: Tapered.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. National Gypsum Company.
 - c. USG Corporation.
2. Core: 5/8 inch , Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. National Gypsum Company.
 - c. USG Corporation.
2. Core: 5/8 inch , Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet .
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints , rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound .
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints , rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile .
 3. Level 3: Where indicated on Drawings .
 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated .
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 5. Level 5: Where indicated on Drawings .
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
- H. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 09 29 00

SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

B. Related Requirements:

1. Section 09 51 13 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
2. Section 09 51 33 "Acoustical Metal Pan Ceilings" for ceilings consisting of metal-pan units with exposed and concealed suspension systems.

1.2 PREINSTALLATION MEETINGS

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: Class A according to ASTM E 1264.
 2. Smoke-Developed Index: 50 450 or less.

2.2 ACOUSTICAL TILES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
1. Armstrong World Industries, Inc.
- B. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264.
- C. Classification: .
- D. Color: As selected from manufacturer's full range .
- E. Light Reflectance (LR): Not less than 0.80 .
- F. Ceiling Attenuation Class (CAC): Not less than 30 .
- G. Noise Reduction Coefficient (NRC): Not less than 0.7 .
- H. Articulation Class (AC): .
- I. Edge/Joint Detail: As indicated by manufacturer's designation .
- J. Thickness: 5/8 inch .
- K. Modular Size: 24 by 24 inches .

2.3 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; or comparable product by one of the following:
1. .
 2. Armstrong Ceiling & Wall Solutions.
- B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, fully concealed, metal suspension system that complies with applicable requirements in ASTM C 635/C 635M.

- C. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation.
 - 1. Structural Classification: Intermediate -duty system.
 - 2. Access: Upward and , with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.
 - a. Initial Access Opening: In each module, 24 by 24 inches .

2.4 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings according to ASTM C 636/C 636M , seismic design requirements, and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

END OF SECTION 09 51 23

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl base.
 - 2. Rubber stair accessories.
 - 3. Vinyl molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Flexco.
 - 3. Johnsonite; a Tarkett company.
 - 4. VPI Corporation.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
 - 1. Group: I (solid, homogeneous) .
 - 2. Style and Location:
 - a. Style B, Cove: Provide in all areas .
- C. Minimum Thickness: 0.125 inch .
- D. Height: 4 inches As indicated on Drawings.
- E. Lengths: Coils in manufacturer's standard length .
- F. Outside Corners: Preformed .

- G. Inside Corners: Job formed or preformed.
- H. Colors and Patterns: Colors and Patterns shall be selected by Architect .

2.3 RUBBER STAIR ACCESSORIES

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allstate Flooring.
 - 2. American Biltrite.
 - 3. Armstrong World Industries, Inc.
 - 4. Flexco.
 - 5. Johnsonite; a Tarkett company.
 - 6. Nora by Interface.
 - 7. PRF USA Inc.
 - 8. R.C.A. Rubber; SRP Industries.
 - 9. Roppe Corporation.
 - 10. The R.C. Musson Rubber Co.
 - 11. VPI Corporation.
- C. Stair Treads: ASTM F 2169.
 - 1. Type: TS (rubber, vulcanized thermoset) or .
 - 2. Class: 2 (pattern; embossed, grooved, or ribbed).
 - 3. Group: 2 (with contrasting color for the visually impaired).
 - 4. Nosing Style: Square .
 - 5. Nosing Height: 1-1/2 inches .
 - 6. Thickness: 1/4 inch and tapered to back edge .
 - 7. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
 - 8. Integral Risers: Smooth, flat; in height that fully covers substrate.
- D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
 - 1. Style: Toeless, by length matching treads.
 - 2. Thickness: Manufacturer's standard .
- E. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads .
- F. Locations: Provide rubber stair accessories in areas indicated .
- G. Colors and Patterns: Colors and Patterns shall be selected by Architect .

2.4 VINYL MOLDING ACCESSORY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite; a Tarkett company; or comparable product by one of the following:
1. Flexco.
 2. Roppe Corporation.
 3. The R.C. Musson Rubber Co.
 4. Johnsonite; a Tarkett company.
- B. Description: Vinyl transition strips .
- C. Profile and Dimensions: As indicated .
- D. Locations: Provide vinyl molding accessories in areas indicated .
- E. Colors and Patterns: As indicated by manufacturer's designations Match Architect's sample Colors and Patterns shall be selected by Architect .

2.5 INSTALLATION MATERIALS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply one two coat(s).
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Multilayer vinyl plank floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and pattern specified.

C. Shop drawings showing proposed floor layouts.

D. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
2. Static Load (ASTM F970)
3. Dimensional Stability (ASTM F2199)
4. Resistance to Heat (ASTM F1514)

5. Resistance to Light (ASTM F1515)
6. Resistance to Chemicals (ASTM F925)
7. Smoke Density (ASTM E662, Flaming Mode)
8. Coefficient of Friction (ASTM D2047, Slip Resistance): ≥ 0.5

2.2 MULTI-LAYER PLANK VINYL FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
1. Congoleum Flooring.
 2. Gerflor USA.
 3. Mannington Mills, Inc.
 4. Shaw Industries Group, Inc.; Berkshire Hathaway Company.
- B. Tile Standard: Class / ASTM F3261 Class III, Type B
- C. Thickness: 5.5 mm w/ 20 mil wear layer in all areas.
- D. Size: 7 by 48 inches. Alternate sizes will be considered.
- E. Colors and Patterns: Colors and Patterns shall be selected by Architect. Provide up to three different colors/textures/product lines for the project.
- F. The tile shall be 100% waterproof and must be manufacturer approved for installation in areas with topical moisture like bathrooms and kitchens.
- G. The tile shall have an integral underlayment and shall be capable of providing the STC and IIC performance characteristics when installed on the floor assemblies specified in the drawings.
- H. Installation: Click, Floating where STC Ratings are specified. Direct glue where STC ratings are not required for the floors below.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written.

- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. It is the general contractor's responsibility to properly schedule and coordinate the construction schedule to permit the required curing/drying times for gypsum and cement/concrete floors.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis. Review layout with Architect prior to proceeding.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction .
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

END OF SECTION 09 65 19

SECTION 09 68 16 - SHEET CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tufted carpet.
2. Carpet cushion.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture required.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

1.6 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TUFTED CARPET

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Masland Contract; Dixie Group, Inc. (The).
- B. Color: As selected by Architect from manufacturer's full range .
- C. Pattern: Match Architect's samples .
- D. Fiber Content: As permitted by HUD Carpet Standards Bulletin UM 44 .
- E. Fiber Type: .
- F. Pile Characteristic: As permitted by HUD Carpet Standards Bulletin UM 44 pile.
- G. Yarn Twist: .
- H. Yarn Count: .
- I. Density: As permitted by HUD Carpet Standards Bulletin UM 44 .
- J. Pile Thickness: for finished carpet according to ASTM D6859.
- K. Stitches: .
- L. Gage: .
- M. Face Weight: As permitted by HUD Carpet Standards Bulletin UM 44 .
- N. Total Weight: As permitted by HUD Carpet Standards Bulletin UM 44 for finished carpet.
- O. Primary Backing: Manufacturer's standard material .
- P. Roll Width: 12 feet .
- Q. Sustainable Design Requirements:
 - 1. Sustainable Product Certification: level certification according to ANSI/NSF 140.
- R. Performance Characteristics:
 - 1. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
 - 2. Tuft Bind: Not less than 6.2 lbf according to ASTM D1335.
 - 3. Delamination: Not less than 2.5 lbf/in. according to ASTM D3936.

2.2 CARPET CUSHION

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. TredMOR by SCI; Leggett & Platt, Inc.
- B. Traffic Classification: CCC Class I, moderate traffic.
- C. Fiber Cushion: Rubberized jute, mothproofed and sterilized .
 - 1. Weight: As permitted by FHA Carpet Cushion Standards HUD UM 72 .
 - 2. Thickness: As permitted by FHA Carpet Cushion Standards HUD UM 72 plus 5 percent maximum.
 - 3. Density: As permitted by FHA Carpet Cushion Standards HUD UM 72 .
- D. Rubber Cushion: Textured flat .
 - 1. Weight: As permitted by FHA Carpet Cushion Standards HUD UM 72 .
 - 2. Thickness: As permitted by FHA Carpet Cushion Standards HUD UM 72 plus 5 percent maximum.
 - 3. Compression Resistance: As permitted by FHA Carpet Cushion Standards HUD UM 72 at 65 percent according to ASTM D3676.
 - 4. Density: As permitted by FHA Carpet Cushion Standards HUD UM 72 .
- E. Polyurethane-Foam Cushion: .
 - 1. Compression Force Deflection at 65 Percent: As permitted by FHA Carpet Cushion Standards HUD UM 72 according to ASTM D3574.
 - 2. Thickness: As permitted by FHA Carpet Cushion Standards HUD UM 72 .
 - 3. Density: As permitted by FHA Carpet Cushion Standards HUD UM 72 .
- F. Performance Characteristics:
 - 1. Critical Radiant Flux Classification: Not less than 0.22 W/sq. cm according to NFPA 253.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet carpet cushion manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer carpet and carpet cushion manufacturers.
- C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with the Carpet and Rug Institute's CRI 104.

- D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet adhesive, carpet, and carpet cushion manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

- A. Comply with the Carpet and Rug Institute's CRI 104 and carpet manufacturer's carpet and carpet cushion manufacturers' written installation instructions for the following:
 - 1. Direct-glue-down installation.
 - 2. Double-glue-down installation.
 - 3. Carpet with attached-cushion installation.
 - 4. Preapplied adhesive installation.
 - 5. Hook-and-loop installation.
- B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
 - 1. Stretch-in Carpet Installation: Install carpet cushion seams at 90-degree angle with carpet seams.
- C. Install pattern parallel to walls and borders .

- D. Install borders with mitered corner seams.
- E. Do not bridge building expansion joints with carpet.
- F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.
- I. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer and carpet cushion manufacturer and carpet adhesive manufacturer and carpet cushion and adhesive manufacturers.

END OF SECTION 09 68 16

SECTION 09 72 00 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic-polyolefin wall covering.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 286.

2.2 THERMOPLASTIC-POLYOLEFIN WALL COVERING

- A. Manufacturers: Subject to compliance with requirements, undefined:
 1. Carnegie Fabrics, LLC.
- B. Description: Provide products complying with Wallcoverings Association's W-101; free of PVC, chlorine, plasticizers, formaldehyde, heavy metals, and halogenated fire retardants; with water-based inks and coatings; with antimicrobial additives; and in rolls from same production run.
 1. Type: Type II, Medium Duty.
- C. Total Weight: , excluding coatings.
- D. Width: 52 inches .
- E. Backing: Woven fabric.
 1. Fiber Content: Polyester cellulose .
- F. Repeat: Random .
- G. Features:
 1. .
- H. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range .

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining , strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.2 INSTALLATION OF WALL COVERING

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
 - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern 48 inches above the finish floor.
- F. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- I. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- J. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 00

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.
3. Floor sealers and paints.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of topcoat product.

1.3 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <Click here to find, evaluate, and insert list of manufacturers and products.>

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

- B. Colors: As selected by Architect from manufacturer's full range .

2.3 PRIMERS

- A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Exterior Wood Preservative: Solvent-based, zinc or copper naphthenate, penetrating antifungal treatment for exterior wood.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Exterior, Latex Wood Primer: White, waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on exterior wood subject to extractive bleeding.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Exterior, Alkyd/Oil Wood Primer: Alkyd/oil-based primer that is resistant to extractive bleeding when applied to wood substrates with less than 15 percent moisture content; formulated for sag, mold, and microbial resistance; for hiding stains; and for use on exterior wood subject to extractive bleeding.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. Exterior, Latex Block Filler: Water-based, pigmented, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - 2. Minimum Solids Content: Manufacturer's standard percentage solids by volume.
- F. Water-Based Bonding Primer: Pigmented, water-based-emulsion primer formulated for exterior use and to promote adhesion of subsequent specified coatings.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- G. Solvent-Based Bonding Primer: Pigmented, solvent-based primer formulated for exterior use and to seal substrates and promote adhesion of specified subsequent coatings.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- H. Zinc-Rich, Inorganic Primer: Corrosion-resistant, inorganic-based, zinc-rich primer formulated for use on prepared steel subject to severe industrial or marine environments.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- I. Surface-Tolerant Metal Primer: Corrosion-resistant, solvent-based metal primer formulated for use on structural steel and metal fabrications that have been minimally prepared.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)

- J. Quick-Drying, Alkyd Metal Primer: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, exterior steel surfaces.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- K. Alkyd Metal Primer: Corrosion-resistant, solvent-based, alkyd primer formulated for use on prepared ferrous metals subject to industrial and light marine environments.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Sherwin-Williams Company (The).
- L. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- M. Epoxy Metal Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, exterior ferrous- and galvanized-metal surfaces.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- N. Vinyl Wash Primer: Two-component, vinyl butyral/phosphoric acid, wash primer formulated for use over cleaned metal surfaces and zinc-rich primers as a tie coat for subsequent corrosion-resistant primers or finish coatings.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
- O. Quick-Drying Aluminum Primer: Corrosion-resistant, solvent-based, alkyd or modified-alkyd primer formulated for quick-drying capabilities and for use on prepared exterior aluminum.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)

2.4 FINISH COATINGS

- A. Exterior Latex Paint, Flat: Water-based, pigmented coating; formulated for alkali, mold, microbial, and water resistance and for use on exterior surfaces, such as portland cement plaster, concrete, and primed wood.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 - 2. Gloss and Sheen: Maximum gloss of 5 units at 60 degrees and maximum sheen of 10 units at 85 degrees when tested in accordance with ASTM D523 .
- B. Exterior Latex Paint, Low Sheen: Water-based, pigmented coating; formulated for alkali, mold, microbial, and water resistance and for use on exterior surfaces, such as portland cement plaster, concrete, and primed wood.
 - 1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Gloss and Sheen Level: Gloss of 10 to 35 units at 60 degrees and minimum sheen of 10 units at 85 degrees when tested in accordance with ASTM D523 .
- C. Exterior Latex Paint, Semigloss: Water-based, pigmented emulsion coating formulated for alkali, mold, microbial, and water resistance and for use on exterior surfaces, such as masonry, portland cement plaster, and primed wood and metal.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sherwin-Williams Company (The).
 2. Gloss Level: Gloss of 35 to 70 units at 60 degrees when tested in accordance with ASTM D523 .
- D. Exterior Latex Paint, Gloss: Water-based, pigmented, acrylic-copolymer-emulsion coating formulated for alkali, mold, microbial, scrub, blocking (sticking of two painted surfaces), and water resistance and for use on exterior, primed, wood and metal trim, sashes, frames, and doors.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss Level: Gloss of 70 to 85 units at 60 degrees when tested in accordance with ASTM D523 .
- E. Exterior, High-Build Latex Paint: Water-based, high-build, pigmented, emulsion coating; high-solids content improves filling, uniformity, and film build on concrete masonry surfaces. Formulated for abrasion, mold, microbial, and wind-driven rain resistance and for use on exterior masonry, concrete masonry unit, and concrete surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss and Sheen Level: Maximum gloss of 20 units at 60 degrees and maximum sheen of 10 units at 85 degrees when tested in accordance with ASTM D523 .
 3. Minimum Solids Content: Manufacturer's standard percentage solids by volume.
- F. Textured Latex Coating, Flat: Water-based, pigmented coating that contains sand or other hard aggregate and is formulated for use on exterior masonry, concrete masonry unit, and concrete surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss and Sheen Level: Maximum gloss of 5 units at 60 degrees and maximum sheen of 10 units at 85 degrees when tested in accordance with ASTM D523 .
 3. Aggregate Size: Manufacturer's standard .
- G. Textured Latex Coating, Low Sheen: Water-based, pigmented coating that contains sand or other hard aggregate and is formulated for use on exterior masonry, concrete masonry unit, and concrete surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss and Sheen Level: Gloss of 5 to 25 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523 .
 3. Aggregate Size: Manufacturer's standard .

- H. Exterior Alkyd Enamel, Flat: Solvent-based, pigmented, alkyd enamel formulated for mold, microbial, and water resistance and for use on exterior, primed, wood and metal surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Gloss and Sheen Level: Maximum gloss of 5 units at 60 degrees and maximum sheen of 10 units at 85 degrees when tested in accordance with ASTM D523 .
- I. Exterior Alkyd Enamel, Semigloss: Solvent-based, pigmented, alkyd enamel formulated for mold, microbial, and water resistance and for use on exterior, primed, wood and metal surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Gloss Level: Gloss of 35 to 70 units at 60 degrees when tested in accordance with ASTM D523 .
- J. Exterior Alkyd Enamel, Gloss: Solvent-based, pigmented, alkyd enamel formulated for mold, microbial, and water resistance and for use on exterior, primed, wood and metal surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Gloss Level: Gloss of 70 to 85 units at 60 degrees when tested in accordance with ASTM D523 .
 3. Fineness of Grind: Manufacturer's standard .
- K. Quick-Drying Alkyd Enamel, Semigloss: Solvent-based, alkyd or modified-alkyd enamel formulated for quick-drying capabilities and for use on exterior, primed, metal and dimensionally stable wood surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Gloss Level: Gloss of 35 to 70 units at 60 degrees when tested in accordance with ASTM D523 .
- L. Quick-Drying Alkyd Enamel, Gloss: Solvent-based, alkyd or modified-alkyd enamel formulated for quick-drying capabilities and for use on exterior, primed, metal and dimensionally stable wood surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Gloss Level: Minimum gloss of 85 units at 60 degrees when tested in accordance with ASTM D523 .
- M. High-Build Epoxy Paint, Low Gloss: High-solids, two-component epoxy; formulated for use on exterior concrete, masonry, and primed-metal surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Gloss and Sheen Level: Maximum gloss of 25 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523 .
- N. Exterior, Water-Based, Light Industrial Coating, Low Sheen: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
1. [<Click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Gloss and Sheen Level: Gloss of 10 to 25 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523 .
- O. Exterior, Water-Based, Light Industrial Coating, Semigloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss Level: Gloss of 35 to 70 units at 60 degrees when tested in accordance with ASTM D523 .
- P. Exterior, Water-Based, Light Industrial Coating, Gloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss Level: Gloss of 70 to 85 units at 60 degrees when tested in accordance with ASTM D523 .

2.5 FLOOR SEALERS AND PAINTS

- A. Latex Floor Paint, Low Gloss: Water-based, pigmented coating formulated to hide stains, for alkali and incidental water resistance, and for use on exterior, concrete and primed-wood surfaces subject to low to medium foot traffic.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss and Sheen Level: Maximum gloss of 25 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523 .
 3. Slip-Resistant Aggregate: Manufacturer's standard additive .
- B. Latex Deck Coating: Water-based, high-solids, acrylic-emulsion coating; formulated for use on exterior, concrete and wood-board traffic surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
 2. Gloss Level: Manufacturer's standard .
 3. Minimum Solids Content: Manufacturer's standard percentage solids by volume.
 4. Surface Texture: Slip resistant.
- C. Alkyd Floor Enamel, Gloss: Solvent-based, alkyd enamel; self-priming where applied to bare wood; formulated to hide stains, for durability, for microbial and abrasion resistance, and for use on exterior, wood-board, traffic surfaces.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Pratt & Lambert; a subsidiary of The Sherwin-Williams Company; or comparable product by one of the following:
 - a. .
 - b. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.

2. Gloss Level: Gloss of 70 to 85 units at 60 degrees when tested in accordance with ASTM D523 .
3. Slip-Resistant Aggregate: Manufacturer's standard additive .
- D. Water-Based, Concrete-Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on exterior, concrete traffic surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>
- E. Solvent-Based, Concrete-Floor Sealer: Clear, acrylic, solvent-based sealer formulated for oil, gasoline, alkali, and water resistance and for use on exterior, concrete traffic surfaces.
 1. <Click here to find, evaluate, and insert list of manufacturers and products.>

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- B. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions.

- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Steel and Iron Substrates:
 - 1. Water-Based, Light Industrial Coating System :
 - a. Prime Coat: Alkyd metal primer .
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, semigloss .
 - 2. Alkyd System :
 - a. Prime Coat: .
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, flat semigloss .
- B. Cementitious Composition Board Substrates: Siding Trim Panels .
 - 1. Latex System :
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, semigloss .
- C. Plastic-Trim-Fabrication Substrates:
 - 1. Latex System :
 - a. Prime Coat: Water-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, semigloss .
 - 2. Water-Based, Light Industrial Coating System :
 - a. Prime Coat: -based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, semigloss .

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.
3. Floor sealers and paints.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of topcoat product.

C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

D. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, products may include, but are not limited to the following

1. Sherwin-Williams Company (The).

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range .

1. Ten percent of surface area will be painted with deep tones.

2.3 PRIMERS

A. Interior/Exterior Latex Block Filler: Water-based, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.

1. Manufacturers: Subject to compliance with requirements, products may include, but are not limited to the following
 - a. Sherwin-Williams Company (The).

B. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

1. Manufacturers: Subject to compliance with requirements, products may include, but are not limited to the following
 - a. Sherwin-Williams Company (The).

C. Anti-Corrosive Epoxy Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, interior ferrous- and galvanized-metal surfaces.

1. Manufacturers: Subject to compliance with requirements, products may include, but are not limited to the following
 - a. Sherwin-Williams Company (The).

2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

1. Manufacturers: Subject to compliance with requirements, products may include, but are not limited to the following
 - a. Sherwin-Williams Company (The).
2. Gloss and Sheen Level: Manufacturer's standard eggshell finish for walls, flat for ceilings, and semi-gloss for all trim and painted base.

2.5 FLOOR SEALERS AND PAINTS

- A. Water-Based Concrete Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, products may include, but are not limited to the following
 - a. Sherwin-Williams Company (The).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- B. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
- C. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- C. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. .
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Concrete Stain System :
 - a. First Coat: Matching topcoat.
 - b. Topcoat: Interior concrete stain.
- B. Concrete Substrates, Traffic Surfaces:
 - 1. Water-Based Concrete Floor Sealer System :
 - a. First Coat: Matching topcoat.
 - b. Topcoat: Water-based concrete floor sealer.
- C. Steel Substrates:
 - 1. Institutional Low-Odor/VOC Latex System :
 - a. Prime Coat: Water-based rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, semi-gloss .
- D. Gypsum Board Substrates:
 - 1. Institutional Low-Odor/VOC Latex System :
 - a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, eggshell .

END OF SECTION 09 91 23

SECTION 10 14 23 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs.

B. Related Requirements:

1. Section 10 14 23.16 "Room-Identification Panel Signage" for room-identification signs that are directly attached to the building.
2. Section 10 14 26 "Post and Panel/Pylon Signage" for freestanding signs.
3. Section 26 52 13 "Emergency and Exit Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least .
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For , from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
- B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces .
- C. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction and ICC A117.1 .

2.2 PANEL SIGNS

- A. Panel Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Basis-of-Design Product: Subject to compliance with requirements, provide inpro Corporation; or comparable product by one of the following:
- a. .
- b. inpro Corporation.
2. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of phenolic base sheet to produce composite sheet.
- a. Surface-Applied, Raised Graphics: Applied polymer characters and Braille .
3. Sign-Panel Perimeter: Finish edges smooth.
- a. Edge Condition at Vertical Edges at Horizontal Edges : Beveled .
- b. Corner Condition in Elevation: Square .
4. Mounting: Manufacturer's standard method for substrates indicated Surface mounted to wall with concealed anchors .
5. Surface Finish and Applied Graphics:
- a. Integral Aluminum Finish: <Insert finish>.

2.3 PANEL-SIGN MATERIALS

- A. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
1. Use concealed fasteners and anchors unless indicated to be exposed.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
 3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
 4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 10 14 23

SECTION 10 14 23.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
 - 1. Section 10 14 16 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least half size .
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in ICC A117.1 and UFAS. .

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ACE Sign Systems, Inc.
 - b. Advance Corporation.
 - c. APCO Graphics, Inc.
 - d. ASE, Inc.
 - e. Best Sign Systems, Inc.
 - f. inpro Corporation.
 - g. Mohawk Sign Systems.
 - h. Vista System, LLC.
 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign .
 - b. Surface-Applied Graphics: Applied vinyl film .
 - c. Color(s): As selected by Architect from manufacturer's full range .
 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition at Vertical Edges at Horizontal Edges : Beveled .
 - b. Corner Condition in Elevation: Square .
 4. Frame: Entire perimeter .
 - a. Material: Aluminum .
 - b. Profile: Beveled .
 - c. Corner Condition in Elevation: Mitered .
 - d. Finish and Color: As selected by Architect from manufacturer's full range .
 5. Mounting: Surface mounted to wall with concealed anchors or adhesive .

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

END OF SECTION 10 14 23.16

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - Part 1 - General

1.1 Summary

- A. This section includes the following types of wall protection systems:
 - 1. Corner Guards
- B. Related sections: The following sections contain requirements related to this section:
 - 1. Handrails, Bumper Guards, Crash Rails, Accent Rails, Wall Covering, Wall Panels, Door Protection; refer to section 10 26 00 "Wall and Door Protection"
 - 2. Blocking in walls for fasteners; refer to section 09 22 00 "Supports for Plaster and Gypsum Board"

1.2 References

- A. National codes (IBC, UBC, SBCCI, BOCA and Life Safety)
- B. American Society for Testing and Materials (ASTM)
- C. Underwriters Laboratories (UL)

1.3 Submittals

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification section 01 33 00 "Submittal Procedures":
- B. Product data and detailed specifications for each system component and installation accessory required, including installation methods for each type of substrate.
- C. Shop drawings showing locations, extent, and installation details of corner guards. Show methods of attachment to adjoining construction.
- D. Samples for verification purposes: Submit the following samples, as proposed for this work, for verification of color, texture, pattern and end cap attachment and alignment:
 - 1. 12" (304.8mm) long sample of each model specified including end cap.
- E. Product test reports from a qualified independent testing laboratory showing compliance of each component with requirements indicated.
- F. Maintenance data for wall protection system components for inclusion in the operating and maintenance manuals specified in Division 1.

1.4 Quality Assurance

- A. Installer qualifications: Engage an installer who has no less than 3 years' experience in installation of systems similar in complexity to those required for this project.
- B. Manufacturer's qualifications: Not less than 5 years' experience in the production of specified products and a record of successful in-service performance.
- C. Code compliance: Assemblies should conform to all applicable codes including IBC, UBC, SBCCI, BOCA and Life Safety.
- D. Fire performance characteristics: Provide engineered PVC FREE wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class A/1 characteristics listed below:
 - 1. Flame spread: 25 or less
 - 2. Smoke developed: 450 or less
- E. Impact strength: Provide wall protection components that have been tested for impact using a ram-type impact test in accordance with the applicable provisions of ASTM F476 -84.
- F. Chemical and stain resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.
- G. Color match: Provide wall protection components that are color matched in accordance with the following:
 - 1. Delta Ecmc of no greater than 1.0 using CIELab color space. (Specifier note: Construction Specialties' colors are matched under cool white fluorescent lighting and computer controlled within manufacturing tolerances. Color may vary if alternate lighting sources are present.)
- H. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture, and physical properties.

1.5 Delivery, Storage and Handling

- A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.
- B. Store materials in original, undamaged packaging in a cool, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 40°F (4°C) and a maximum of 100°F (38°C) should be maintained.
- C. Material must be stored flat.

1.6 Project Conditions

- A. Materials must be acclimated in an environment of 65°-75°F (18°-24°C) for at least 24 hours prior to beginning the installation.
- B. Installation areas must be enclosed and weatherproofed before installation commences.

1.7 Warranty

- A. Acrovyn 5-year Limited Warranty
 - 1. Applies to Interior Wall Protection orders that do not include recommended components or accessories
 - a. Assemblies = Brackets, Hardware
 - b. Accessories = Primer, Adhesive, Caulk, Trims & Moldings
- B. Limited Lifetime Systems Warranty
 - 1. Applies to CS Interior Wall Protection projects that include all recommended components and accessories related to CS Interior Wall Protection Products.
 - a. Assemblies = Brackets, Hardware
 - b. Accessories = Primer, Adhesive, Caulk, Trims & Moldings

PART 2 - Part 2 – Products

2.1 Manufacturers

- A. Basis of design: Construction Specialties, Inc., 3 Werner Way, Lebanon, NJ 08833 USA 800-233-8493; email: cet@c-sgroup.com
- B. Drawings and specifications are based on manufacturer's literature from Construction Specialties, Inc. unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner.
- C. Request for substitutions must follow the requirements in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.
- D. Substitutions: Only products approved by the architect will be acceptable. Submit the following listed items (2-5) with proper documentation as required for substitution requests. Allow an additional (15) working days for any substitution review in addition to the standard review time for submittals.

2.2 Materials

- A. Engineered PVC FREE: Extruded material should be high-impact Acrovyn 4000 with Shadowgrain texture, nominal .078" (1.98mm) thickness. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer. Colors to be indicated in the finish schedule from one of manufacturer's available colors and patterns.

- B. Regrind PVC FREE: PVC-free regrind retainer for model SSM-20N.
- C. Aluminum: Extruded aluminum retainers should be 6063-T6 alloy, nominal .062" (1.57mm) thickness for model SSM-20AN. Minimum strength and durability properties as specified in ASTM B221.
- D. Fasteners: All fasteners to be non-corrosive and compatible with aluminum retainers. All necessary fasteners to be supplied by the manufacturer.

2.3 Corner Guards

- A. Engineered PVC FREE Corner Guards to be CS Acrovyn: Surface mounted guards consisting of continuous retainer with snap-on Acrovyn 4000 cover. Color matched end caps to be provided for both partial and full height applications. Attachment hardware shall be appropriate for wall construction.
 - 1. Model SSM-20N 90° surface mounted corner guard with 2" (50.8mm) legs, 1/4" (6.4mm) radius cover and regrind PVC FREE retainer. Specify model SSM-20AN for continuous aluminum retainer. Select from one of Acrovyn™ solid colors, Acrovyn™ Woodgrains or Acrovyn™ Brushed Metals simulated patterns. Optional horizontal accent reveal available in Black only.

2.4 Fabrication

- A. General: Fabricate wall protection systems to comply with requirements indicated for design, dimensions, detail, finish, and member sizes.

PART 3 - Part 3 - Execution

3.1 Examination

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 Preparation

- A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
- B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.3 Installation

- A. Install the work of this section in strict accordance with the manufacturer's recommendations, using only approved mounting hardware and locating all components firmly into position, level and plumb.
- B. Temperature at the time of installation must be between 65°-75°F (18°-24°C) and be maintained for at least 48 hours after the installation.
- C. Adjust installed end caps as necessary to ensure tight seams.

3.4 Cleaning

- A. General: Immediately upon completion of installation, clean material in accordance with manufacturer's recommended cleaning method.
- B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.5 Protection

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION 10 26 00

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Private-use bathroom accessories.
3. Hand dryers.
4. Underlavatory guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 2 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
2. Shower Seats: Installed units are able to resist 250 lbf applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Roll) Dispenser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset .
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with standard spindle .
5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
6. Material and Finish: Chrome-plated zinc alloy (zamac) or steel Satin-finish aluminum bracket with plastic spindle .

- B. Waste Receptacle :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Mounting: Open top, recessed Self-closing disposal-opening cover, recessed Semirecessed Surface mounted Wall mounted for corner installation Freestanding .
3. Minimum Capacity: .
4. Material and Finish: .
5. Liner: Reusable vinyl liner .
6. Lockset: Tumbler type for waste receptacle.

- C. Automatic Soap Dispenser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in liquid or lotion form.
3. Mounting: Surface mounted.
4. Capacity: .
5. Materials: .
6. Refill Indicator: LED indicator.
7. Low-Battery Indicator: LED indicator.

D. Grab Bar :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings .

E. Seat-Cover Dispenser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Mounting: Surface mounted .
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: ABS plastic, gray .
5. Lockset: Tumbler type.

F. Mirror Unit :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Frame: Stainless steel angle, 0.05 inch thick .
 - a. Corners: Manufacturer's standard .
3. Size: As indicated on Drawings .
4. Shelf:
 - a. Type: Integral, welded .
 - b. Depth: 5 inches .
5. Hangers: Manufacturer's standard rigid, tamper and theft resistant .

G. Hook :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: Combination hat and coat hook .
3. Mounting: Concealed .
4. Material and Finish: Polished chrome-plated zinc alloy (zamac) .

2.3 PRIVATE-USE BATHROOM ACCESSORIES

A. Private-Use Toilet Tissue Dispenser :

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: Single -roll dispenser with the following features:
 - a. Hood.
 - b. .
3. Mounting: Recessed .
4. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
5. Material and Finish: Polished chrome-plated zinc alloy (zamac) .

B. Private-Use Shower Curtain Rod :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: 1-inch- outside diameter, straight rod.
3. Configuration:
4. Mounting Flanges: Designed for concealed fastening, in in material and finish matching rod .
5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .
6. Features: Integral chrome-plated brass glide hooks.

C. Private-Use Folding Shower Seat :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Configuration: As provided by shower manufacturer .
3. Seat: As provided by shower manufacturer .
4. Mounting Mechanism: .
5. Dimensions: As provided by shower manufacturer .

D. Private-Use Medicine Cabinet :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Mounting: Surface mounted.
3. Size: As noted on Drawings .
4. Door: Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch .
5. Shelves: .
6. Material and Finish:
 - a. Cabinet: Steel with corrosion-resistant finish.
 - b. Mirror Frame: Stainless steel or baked enamel .
 - c. Door: Rust-resistant, Baked-Enamel Interior .
 - d. Hinge: Steel piano hinge reversible .

- e. Shelves: Painted steel or polystyrene .

E. Private-Use Towel Bar :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: 3/4-inch- round tube with circular end brackets .
3. Mounting: Flanges with concealed fasteners.
4. Length: 24 inches .
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) Polished aluminum .

2.4 HAND DRYERS

A. Warm-Air Dryer :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; or comparable product by one of the following:
 - a. .
 - b. Bradley Corporation.
2. Description: Standard-speed, warm-air hand dryer.
3. Mounting: Recessed Semirecessed Surface mounted.
 - a. Protrusion Limit: Installed unit protrudes maximum 4 inches from wall surface.
4. Operation: Touch-button activated with timed power cut-off switch.
 - a. Automatic Shutoff: At 40 seconds.
5. Maximum Sound Level: 67 dB.
6. Cover Material and Finish: Molded plastic, gray .
7. Electrical Requirements: 115 V, 13 A, 1500 W .

2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Plumberex Specialty Products, Inc.; TRAP GEAR or comparable product by one of the following:
 - a. .
 - b. Plumberex Specialty Products, Inc.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

END OF SECTION 10 28 00

SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET FE

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Babcock-Davis.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - c. Larsen's Manufacturing Company.

B. Cabinet Construction: Nonrated and Two-hour fire rated.

1. Ratings shall match or exceed the rating of the wall they are installed in.
 2. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet .
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Steel sheet Same material and finish as door.
- F. Door Material: Steel sheet .
- G. Door Style: Solid opaque panel with frame .
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- I. Accessories:
1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle .
 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect .
 - a. Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER ."
 - 1) Location: Applied to cabinet door .
 - 2) Application Process: Decals or Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red .
 - 4) Orientation: Vertical .
- J. Materials:
1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Color: As selected by Architect from manufacturer's full range .
 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, .

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals or vinyl lettering at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 10 44 13

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Ansul; brand of Johnson Controls International plc, Building Solutions North America.
 - b. Babcock-Davis.
 - c. Buckeye Fire Equipment Company.
 - d. Guardian Fire Equipment, Inc.
 - e. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - f. Kidde; Carrier Global Corporation.
 - g. Larsen's Manufacturing Company.
 - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type: UL-rated, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
 - 1. One 2.5 lb capacity unit on a hook in each dwelling unit.
 - 2. 10 lb capacity in a cabinet where specified for all non-residential unit areas.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at 42 inches maximum above finished floor. Confirm mounting heights and locations in field with Architect.

- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

SECTION 10 55 00.13 - USPS-DELIVERY POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mail receptacles.
2. Cluster box units.
3. Parcel lockers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For postal specialties. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Furnish lock keys according to USPS requirements; with temporary identification for their respective locks, bagged, and securely taped inside the collection compartment for shipping.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MAIL RECEPTACLES

- A. Front-Loading Mail Receptacles : USPS-STD-4C; consisting of multiple compartments with fixed, solid compartment backs, enclosed within a recessed wall box.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Postal Products Unlimited, Inc.; or comparable product by one of the following:
 - a. 2B Global Inc.
 - b. American Eagle Mailbox Mfg. Corp.
 - c. National Mailboxes; a division of NMHP, Inc.
 - d. W. A. Charnstrom Company.
 - e. Postal Products Unlimited, Inc.
2. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; prepared to receive master-door lock.
 - a. Master-Door Lock: Door prepared to receive lock provided by local postmaster.
3. Compartments: As indicated on Drawings.
4. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by USPS-STD-4C. Provide mail slot in the compartment with master-door lock.
 - a. Compartment-Door Locks: USPS-L-1172C; with three keys for each compartment door.
 - b. Parcel-Locker-Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker-compartment key, which opens compartment and is retained once opened.
5. Frames: Extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
6. Concealed Components and Mounting Frames: Aluminum or steel sheet.
7. Exposed Aluminum Finish:
 - a. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range .

2.2 CLUSTER BOX UNITS (CBUs)

- A. Cluster Box Units (CBUs): USPS-B-1118G; consisting of multiple compartments enclosed within a freestanding, pedestal-mounted enclosure.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Postal Products Unlimited, Inc.; or comparable product by one of the following:
 - a. American Eagle Mailbox Mfg. Corp.
 - b. National Mailboxes; a division of NMHP, Inc.
 - c. Postal Products Unlimited, Inc.
- B. Compartment Enclosure: Aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:
 1. Type I: Eight compartments 12 inches wide by 3 inches high by 15 inches deep, one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep, one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep, and another parcel-locker compartment 12 inches wide by 13-1/2 inches high by 15 inches deep.
 2. Type II: 12 compartments 12 inches wide by 3 inches high by 15 inches deep, one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep, and one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep.
 3. Type III: 16 compartments 12 inches wide by 3 inches high by 15 inches deep, one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep, one

- parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep, and another parcel-locker compartment 12 inches wide by 13-1/2 inches high by 15 inches deep.
4. Type IV: 13 compartments 12 inches wide by 4-3/4 inches high by 15 inches deep, one outgoing mail compartment 12 inches wide by 4-3/4 inches high by 15 inches deep, and one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep.
- C. Compartment Doors and Frames: One-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.
1. Tenant Identification: Number applied into recess of compartment door.
 2. Compartment-Door Locks: USPS-L-1172C; with three keys for each compartment door.
 3. Parcel-Locker-Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker-compartment key, which opens compartment and is retained once opened.
- D. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.
- E. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in postal gray (light gray).

2.3 PARCEL LOCKERS

- A. Front-Loading Parcel Lockers, Recessed : USPS-STD-4C; consisting of single or multiple compartments enclosed within a larger enclosure of type indicated below.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Postal Products Unlimited, Inc.; or comparable product by one of the following:
 - a. American Eagle Mailbox Mfg. Corp.
 - b. Florence Corporation; Gibraltar Industries Company.
 - c. Jensen Mailboxes Manufacturing Company.
 - d. National Mailboxes; a division of NMHP, Inc.
 - e. Postal Products Unlimited, Inc.
 2. Enclosure Type: Recessed.
 3. Compartments: As indicated on Drawings.
 4. Front-Loading Master Door: Fabricated to hold compartment doors; prepared to receive master-door lock provided by local postmaster.
 5. Compartment Doors and Frames: Fabricated from same material and finish as adjacent mail receptacles . Equip each compartment door with lock; identification; and concealed, full-length, spring-loaded, flush hinge on right side.
 - a. Compartment Identification: Black, sequential numbers stamped onto recess in face of compartment door.
 - b. Compartment-Door Locks: Dual-lock security system in which master lock provides access to customer lock (USPS-L-1172C) and parcel-locker key opens compartment and is retained once opened.
 6. Aluminum Finish:
 - a. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range .

2.4 ACCESSORIES

2.5 FABRICATION

- A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.
- B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.
- C. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mail Receptacles: Install mail receptacles with center of tenant-door lock cylinders and bottom of compartments at the maximum and minimum heights above finished floor established by the USPS and manufacturer's written instructions.
- B. Pedestal-Mounted Postal Specialties: Anchor units with 1/2-inch- diameter, stainless-steel anchor bolts with hooked ends.
- C. Collection Boxes: Install collection boxes with centerline of mail slots not more than 48 inches above finished floor.

3.2 FIELD QUALITY CONTROL

- A. Arrange for USPS personnel to examine and test postal specialties served by the USPS after they have been installed according to USPS regulations.

END OF SECTION 10 55 00.13

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.
4. Dishwasher
5. Garbage Disposal

1.2 PREINSTALLATION MEETINGS

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For indicated products, indicating compliance with requirements for ENERGY STAR product labeling.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 RANGES

A. Electric Range RG 1: Slide-in range with one oven and complying with AHAM ER-1.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of Design: Whirlpool WFE505W0HW. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. Electric Burner Elements: Four coil radiant -type burners.
3. Anti-Tip Device: Manufacturer's standard.
4. Material: Porcelain-enameled steel with manufacturer's ceramic-glass cooktop.

B. Electric Range RG-ADA: Slide-in range with one oven and complying with AHAM ER-1.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of design: Whirlpool WEE515SALS. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. Electric Burner Elements: Four ceramic-glass cooktop burners.
3. Anti-Tip Device: Manufacturer's standard.
4. Material: Porcelain-enameled steel with ceramic-glass cooktop.

2.3 KITCHEN EXHAUST VENTILATION

A. Overhead Exhaust Hood EX #1:

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of Design: Broan-NuTone, LLC BCSEK130WW. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. Type: Wall-mounted, exhaust-hood system.
3. Exhaust Fan: Two-speed fan and with manufacturer's standard capacity.
 - a. Venting: Vented to outside through wall.
4. Finish: Baked enamel.

2.4 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer RF #1: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of design: Whirlpool WRT549SZD. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. Type: Freestanding .
3. Storage Capacity:
 - a. Refrigeration Compartment Volume: 14 cu. ft.
 - b. Freezer Volume: 5 cu. ft.
4. General Features:

- a. Interior light in refrigeration compartment.
 - b. Automatic defrost.
5. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
6. Front Panel(s): Manufacturer's standard Reversible panel(s) with choice of colors.

2.5 DISHWASHER

A. Dishwasher DW #1: Complying with AHAM DW-1.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of design: Whirlpool WDF330PAHW. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. Type: Built-in undercounter.
3. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
4. Front Panel(s): Manufacturer's standard panel with choice of colors.

B. Dishwasher DW #ADA: Complying with AHAM DW-1.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of design: Whirlpool WDF550SAH. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. Type: Built-in undercounter.
3. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
4. Front Panel(s): Manufacturer's standard panel with choice of colors.

2.6 GARBAGE DISPOSAL

A. Garbage Disposal GD #1: Complying with ASSE 1008.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
 - a. Basis of design: InSinkErator Badger 1. Substitutions complying with Section 01 25 00 "Substitution Procedures" will be considered.
2. 1/3 H.P. Motor
3. Continuous feed
4. Galvanized steel grinding elements with two stainless steel 360° swivel lugs
5. Include factory instilled cord.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

END OF SECTION 11 30 13

SECTION 11 82 26 - FACILITY WASTE COMPACTORS

PART 1 - Part 1 –GENERAL

1.1 Description

- A. Furnish and install waste compactor Model: 400-C5 and ancillary equipment as indicated on the Drawings and as specified within.

1.2 Related Work Specified Elsewhere

- A. Concrete work - Section 03300 “Cast in Place Concrete”
- B. Rubbish Chute - Section 11175 “Chutes and Collectors” See Wilkinson
- C. Electrical wiring to control panels, and wiring from control to disconnect box panels - Division 16 “Electrical”
- D. Floor drains and hose bibs - Division 15 “Mechanical”

1.3 Quality Assurance

- A. The equipment shall comply with the National Electric Code and ANSI-Z-245-1.
- B. Manufacturer shall have at least 5 years experience in the manufacture of the specified equipment and shall maintain a servicing and replacement parts system for at least 3 years after installation of equipment.
- C. The work in this section shall be subject to all applicable provisions of governing building codes and ordinances.

1.4 Submittals

- A. Product Data: Submit manufacturer’s product specifications, performance data sheets and installation instructions.
- B. Shop Drawings: Submit plans, elevations, and details for work not fully shown by published product data; include rough in dimensions and service connection.

1.5 Product Delivery, Storage and handling

- A. Protection: Equipment shall be protected at all times from physical damage, dirt, water etc.
- B. Under no condition shall compactor be used for construction trash, or any other use other than what it was intended for.

PART 2 - Part 2 - PRODUCTS

2.1 Compactor

- A. General: Compactor shall be a Wilkinson Model No. 400-C5 manufactured by Wilkinson-Hi-Rise, LLC. Wilkinson Model No.400-C5 fully automatic, electric eye controlled, hydraulically operated, stationary, ram compactor displacing 54 cubic yards of refuse per hour into a heavy duty compaction container of a design compatible with local requirements. The compactor body is fabricated from 1/4" steel plate . Compactor ram is constructed of 1/4" sides, top and bottom. The ram face is 3/8" steel plate, reinforced. Header bar is 5" x 5" x 1/2" steel angle. The integral hopper is made of 1/4" steel plate with a 1/4" back plate to take the impact of falling refuse. The compactor floor is 3/8" thick steel. The 400-C5 produces 31,100 pounds of packing force at 2200 psi.
1. Substitutions: Only products approved by the architect will be acceptable. Submit the following listed items (2-5) with proper documentation as required for substitution requests. Allow an additional (15) working days for any substitution review in addition to the standard review time for submittals.
 2. Request for substitutions must follow the requirements in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.
- B. Operation: The operation shall be automatically controlled when the compaction chamber fills to the level where the photo sensor activates the compaction ram. The compactor ram shall continue to cycle until all refuse is cleared. When the container is full, compactor will automatically shut down and activate the full indicator light.
- C. Hydraulic System: The hydraulic system shall include a 6.5 gpm pump, 5 HP motor, 15 gallon reservoir and directional control valve. System shall be rated for 3000-psi operation.
- D. Electrical System: The electrical system shall include 5 hp, 1725 rpm motor, 208/230/480V, 30 amps, three phase, four wire w/neutral for ground, 60Hz. Furnished with motor starter and 115v control and programmable controller. All components are to be UL labeled.
- E. Photo Sensor: The compactor shall be fitted with a reliable photoelectric sensor. Wiring to control panel shall be in "sealtite" plastic coated sealed conduit.
- F. Control Panel: The control panel shall be mounted to the remote power pack and shall include a key activated on-off switch, start button, manual forward reverse switch, emergency stop/reset button and 80% and 100% full lights.
- G. Safety Features: Compactor door shall be fitted with captive switch not easily defeated to shut the machine down when the access door is opened. Compactor shall automatically shut down to prevent damage from oversize or uncrushable object.
- H. Programmable Controller: The compactor shall be controlled and monitored by a microprocessor, which shall visually allow the user to read the various operations of the compactor. Indicator lights on the board shall include photo eye fault, high temperature, low oil, pressure switch failure, overload fault and solenoid fault. Compactor shall be programmed to automatically shut down after 15 minutes of continuous operation indicating possible photo eye malfunction.

PART 3 - Part 3 - EXECUTION

3.1 Inspection

- A. Inspect the areas and conditions under which units are to be installed. Do not proceed with the work until conditions are satisfactory.

3.2 Installation

- A. Compactors shall be installed in accordance with approved drawings.
- B. Field assembly work: perform minor field assembly work to install certain fragile or projecting parts that were not installed at the factory.
- C. Set each component of work securely and accurately, level and properly aligned with other components and other work. Anchor as required for secure operation.

3.3 Testing and Instructions

- A. Test each item of operational equipment. Provide maintenance manual. Instruct Owner's operation personnel in proper use and maintenance of equipment.

END OF SECTION 11 82 26

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontal louver blinds with polymer slats.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, POLYMER SLATS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CACO, Inc.
2. Comfortex Window Fashions; Comfortex Corporation.
3. Hunter Douglas, Inc.
4. Springs Window Fashions; SWFcontract.
5. TimberBlindsMetroShade; Timberblinds, LLC.

B. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Slats: Polymers that are lead free, UV stabilized, integrally colored, opaque, and will not crack or yellow; antistatic, dust-repellent treated.

1. Width: 1 inches .

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2. Thickness: 0.105 inch .
 3. Features:
 - a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats .
 - D. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrail fully encloses operating mechanisms on three sides and ends.
 1. Manual Lift Mechanism:
 - a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within full operating range .
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
 2. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Operator: Dual cord .
 3. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard .
 4. Manual Lift-Operator and Tilt-Operator Locations: Manufacturer's standard unless otherwise indicated.
 - E. Bottom Rail: Secures and protects ends of ladders and lift cords.
 1. Type: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends .
 - F. Ladders: Braided cord .
 - G. Valance: Manufacturer's standard .
 - H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 - I. Colors, Textures, Patterns, and Gloss:
 1. Slats: As selected by Architect from manufacturer's full range .
 2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated .
- 2.2 HORIZONTAL LOUVER BLIND FABRICATION
- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
 - B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch.

Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
 - 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 - 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
- B. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.
- C. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.

END OF SECTION 12 21 13

SECTION 12 35 30 - RESIDENTIAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes kitchen and vanity cabinets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For residential casework. Include plans, elevations, details, and attachments to other work.
- C. Samples: For casework and hardware finishes.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For casework.

PART 2 - PRODUCTS

2.1 CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bass Cabinet Mfg., Inc.
 - 2. Bishop Cabinets.
 - 3. Blue River Cabinetry.
 - 4. Cabinet Craft LLC.
 - 5. Canyon Creek Cabinet Company.
 - 6. Central Valley Casework, Inc.
 - 7. Continental Cabinets.
 - 8. Crestwood, Inc.
 - 9. Ideal Cabinetry.
 - 10. KraftMaid; Cabinetworks Group.
- B. Quality Standard: Provide cabinets that comply with KCMA A161.1.
 - 1. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with KCMA A161.1.
- C. Door and Drawer Face Style: Flush overlay .

1. Door and Drawer Fronts: Solid-wood stiles and rails, 5/8 inch thick, with 3/4-inch- thick, solid-wood center panels.
- D. Cabinet Style: Face frame .
 1. Face Frames: 3/4-by-1-5/8-inch solid wood with glued mortise and tenon or doweled joints.
- E. Exposed Cabinet End Finish: Wood veneer .

2.2 CABINET MATERIALS

- A. Hardwood Plywood: HPVA HP-1.
- B. Exposed Materials:
 1. Exposed Wood Species: Maple .
 - a. Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.
 - b. Staining and Finish: As selected by Architect from manufacturer's full range.
 2. Plywood: Hardwood plywood with face veneer of species indicated, with Grade A faces and Grade C backs of same species as faces.
 - a. Edge band exposed edges with a minimum of 1/8-inch- thick, solid-wood edging of same species as face veneer.
- C. Semiexposed Materials: Unless otherwise indicated, provide the following:
 1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects. Same species as exposed surfaces.
- D. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; MDF; or hardboard.

2.3 CABINET HARDWARE

- A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range .
- B. Pulls: Wire pulls .
- C. Hinges: Concealed European-style, self-closing hinges .
- D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or Type B05091.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.

2. Drawers: Provide one bumper on back side of drawer front at each corner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install casework with no variations in adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework.
- B. Install casework without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.
- C. Install casework level and plumb to a tolerance of 1/8 inch in 8 feet.
- D. Fasten casework to adjacent units and to backing.
 1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c.
 - a. Fasteners: No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips .
- E. Adjust hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- F. Clean casework on exposed and semiexposed surfaces. Touch up as required to restore damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 12 35 30

SECTION 12 36 23.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plastic-laminate-clad countertops.

1. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: Plastic laminates in each type, color, pattern, and surface finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program .

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: AWI's Quality Certification Program accredited participant .

B. Installer Qualifications: Fabricator of products AWI's Quality Certification Program accredited participant .

1.5 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and

maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
- B. Grade: Custom .
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABET Inc.
 - b. Formica Corporation.
 - c. Laminart LLC.
 - d. Nevamar Company, LLC.
 - e. Pionite; a Panolam Industries International, Inc. brand.
 - f. Wilsonart LLC.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by manufacturer's designations.
 - 2. Match Architect's sample.
 - 3. As selected by Architect from manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Patterns, matte finish.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces As indicated on Drawings.
- F. Core Material: Particleboard made with exterior glue or MDF made with exterior glue .
- G. Core Material at Sinks: Particleboard made with exterior glue or MDF made with exterior glue .
- H. Core Thickness: 3/4 inch .
 - 1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

- I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
 1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130 .
 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 3. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

2.4 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Contact cement .
 1. Adhesive for Bonding Edges: Post-formed integral edge..

2.5 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:
 1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
 2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.
- F. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 23.13

SECTION 12 36 61.13 - CULTURED MARBLE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cultured marble countertops.
2. Integral sinks.
3. Integral backsplashes.
4. Integral end splashes.
5. Loose end splashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, integral sinks, and methods of joining.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Craig Baker Marble Co., Inc.
 2. MarCraft, Inc.
 3. Roma Marble and Stone.
 4. Rynone Manufacturing Corp.

2.2 CULTURED MARBLE COUNTERTOPS

- A. Cultured Marble: Gel-coated solid fabrication of filled plastic resin complying with CSA B45.5/IAPMO Z124.
 1. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Configuration: One-piece units with integral sink bowls and backsplashes unless otherwise indicated, not less than 1/2 inch thick.

1. Front: Straight, slightly eased at top .
2. Backsplash: Straight, slightly eased at cove and top.
3. End Splash: Matching backsplash .

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by cultured marble manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.
- B. Install aprons to backing and countertops with adhesive. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- C. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.13

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material apron fronts.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
 1. Basis-of-Design Product: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
 - a. DuPont; DuPont de Nemours, Inc.
 - b. Formica Corporation.
 - c. Wilsonart LLC.
 2. Type: Provide Standard type unless Special Purpose type is indicated.
 3. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."
 - 1. Grade: Economy.
- B. Countertops:
 - 1. 3/4-inch- thick, solid surface material with front edge built up with same material.
 - 2. 1/4-inch- thick, solid surface material laminated to 3/4-inch- thick particleboard with exposed edges built up with 3/4-inch- thick, solid surface material.
- C. Backsplashes: 1/2-inch- thick, solid surface material.
- D. Joints:
 - 1. Fabricate countertops without joints.
- E. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

- F. Install aprons to backing and countertops with adhesive.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 12 36 61.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ISFA 3-01.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Cambria.
 - b. DuPont; DuPont de Nemours, Inc.
 - c. LG Hausys, Ltd.
 - d. Lotte Chemical Co., LTD.
 - e. Terrazzo & Marble Supply Companies.
 - f. Vicostone USA.
 - g. Wilsonart LLC.
 2. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Composite Wood Products: Verify products are made without added urea formaldehyde.
- C. Composite Wood Products: Verify products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- D. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- E. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WT's "Architectural Woodwork Standards."
 - 1. Grade: Custom .
- B. Configuration:
 - 1. Front: Half Bullnose .
 - 2. Backsplash: Straight, slightly eased at corner .
 - 3. End Splash: Matching backsplash.
- C. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 1/2-inch- thick, quartz agglomerate.
- E. Joints:
 - 1. Fabricate countertops generally without joints.
 - 2. Fabricate countertops in sections for joining in field for corners only.
- F. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
 - 1. Verify adhesives have a VOC content of 70 g/L or less.
 - 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer.
- B. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- E. Install aprons to backing and countertops with adhesive.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- G. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.19

SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - Part 1 - General

1.1 1.01 Summary

- A. This section includes the following types of entrance flooring systems:
 - 1. 1. Floor Mats & Frame Assemblies
- B. Related Sections: The following sections contain requirements related to this section:
- C. 1. Grouting frames into recess; refer to sections 03300 "Cast-In-Place Concrete" and section 03600 "Grout"

1.2 1.02 References

- A. American Society for Testing and Materials (ASTM)
- B. The Aluminum Association
- C. The Carpet and Rug Institute (CRI)
- D. The National Floor Safety Institute (NFSI)
- E. International Organization for Standardization (ISO)

1.3 1.03 Submittals

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification section 01300.
- B. Product data for each type of floor mat and frame specified including manufacturer's specifications and installation instructions.
- C. Shop drawings in sufficient detail showing layout of mat and frame specified including details indicating construction relative to materials, direction of traffic, spline locations, profiles, anchors and accessories.
- D. Samples for verification purposes: Submit an assembled section of floor mat and frame members with selected tread insert showing each type of color for exposed floor mat, frame and accessories required.
 - 1. PediMat® M1 standard size 9" x 10" Mill Finish with Midnight color standard color
- E. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor mats.

1.4 1.04 Quality Assurance

- A. Flammability in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m².
- B. Slip resistance in accordance with ASTM D-2047-96, Coefficient of Friction, minimum 0.60 for accessible routes.
- C. Standard rolling load performance is 350 lb./wheel with larger loading requirements as specified (load applied to a solid 5" x 2" wide polyurethane wheel, 1000 passes without damage).
- D. Single Source Responsibility: Obtain floor mats and frames from one source of a single manufacturer.
- E. Utilize superior structural aluminum alloy 6063-T6 for rail connectors.
- F. Utilize a manufacturer that is ISO 9001 & 14001 certified.

1.5 1.05 Delivery, Storage and Handling

- A. Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labeled to identify manufacturer.

1.6 1.06 Project Conditions

- A. Field measurements: Check actual openings for mats by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

PART 2 - Part 2 - Products

2.1 2.01 Manufacturer

- A. Construction Specialties, 3 Werner Way, Lebanon, NJ 08833 USA 800-233-8493;
- B. Drawings and specifications are based on manufacturer's literature from Construction Specialties, Inc. unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner.
- C. Substitutions: Only products approved by the architect will be acceptable. Submit the following listed items with proper documentation as required for substitution requests. Allow an additional (15) working days for any substitution review in addition to the standard review time for submittals.
- D. Request for substitutions must follow the requirements in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.

2.2 2.02 Materials

- A. Aluminum - ASTM B 221, alloys 6063-T5, 6063-T6 for extrusions.
- B. Regrind PETG/Polyurethane extrusion.
- C. Flexible TPE extrusions.
- D. Tread insert options - refer to section 2.05.

2.3 2.03 Floor Mats

- A. Model and Description - M1 Pedimat Exposed hinge rail connectors shall be extruded 6063-T6 aluminum complete with perforations for drainage. Tread rails shall be manufactured from high-impact Regrind PET-G complete with co-extruded soft-durometer cushions. Overall depth without frame is 7/16" (11.1 mm). Supplied in mill (standard) finish.

2.4 2.04 Mat Frames

- A. LB – Level Base Frame shall be a 3/4"(19.1mm) deep recessed frame in 6063-T5 aluminum alloy (optional architectural bronze) with 1/4"(6.4mm) wide exposed surface. Black TPE trim fillers shall be furnished as required when standard 2" (50.8mm) tread spacing cannot be maintained. Frame color shall be supplied in mill (standard) or one of 9 optional colors as offered by manufacturer. (Custom colors are available.) Choose from anodized or heavy-duty powder coat finish. Note: Installer shall use recommended latex screed to ensure level base.

2.5 2.05 Tread Insert Options

- A. R - Rubber shall include a flexible TPE tread insert in color Black

PART 3 - Part 3 - Execution

3.1 3.01 Examination

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 3.02 Preparation

- A. Manufacturer shall offer assistance and guidance to provide a template of irregular shaped mat assemblies to ensure a proper installation.

3.3 3.03 Installation

- A. Install the work of this section in strict accordance with the manufacturer's recommendations.
- B. Set mat at height recommended by manufacturer for most effective cleaning action.
- C. Coordinate top of mat surface with bottom of doors that swing across to provide ample clearance between door and mat.

3.4 3.04 Cleaning

- A. It is important to the life cycle of the entrance mat that a maintenance schedule be developed which includes regular vacuuming and extraction that correctly matches the amount of traffic the mat incurs.

3.5 3.05 Protection

- A. After completing required frame installation and concrete work, provide temporary filler of plywood or fiberboard in recess, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of substantial completion.
- B. Defer installation of floor mats until time of substantial completion of project.

END OF SECTION 12 48 13

SECTION 14 21 23.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER
ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Machine-room-less electric traction passenger elevators.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
2. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples: For each type of exposed finish involving color selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded.

1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 3 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Otis Worldwide Corporation; Otis Gen2® Underslung Elevator System 2500 lb Passenger Cab @ 150 fpm or comparable product by one of the following:

1. Mitsubishi Electric US, Inc.
2. Schindler Elevator Corp.
3. ThyssenKrupp Elevator.
4. Otis Worldwide Corporation.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

- B. Elevator Description:

1. Group Number: 1 .
2. Elevator Number(s): 1, 2 .
3. Rated Load: 2500 lb .
4. Rated Speed: 150 fpm .
5. Operation System: Group automatic operation .
6. Auxiliary Operations:
 - a. Standby power operation.
 - b. service at all floors.
7. Security Features: Card-reader operation .
8. Dual Car-Control Stations: Provide two car-control stations in each elevator; equip only one with required keyswitches if any.
9. Car Enclosures:

- a. Inside Width: Not less than 78" from side wall to side wall.
 - b. Inside Depth: Not less than 52" from back wall to front wall (return panels).
 - c. Inside Height: Not less than 93 inches to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - f. Side and Rear Wall Panels: Satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - g. Reveals: Satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - h. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - i. Ceiling: Luminous ceiling .
 - j. Handrails: 1-1/2 inches round satin stainless steel , at sides and rear of car.
 - k. Floor prepared to receive resilient flooring (specified in Section 09 65 16 "Resilient Sheet Flooring").
10. Hoistway Entrances:
- a. Width: 42 inches .
 - b. Height: 84 inches .
 - c. Type: Single-speed side sliding .
 - d. Frames : Satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - e. Doors : Satin stainless steel, ASTM A480/A480M, No. 4 finish .
11. Hall Fixtures : Satin stainless steel, ASTM A480/A480M, No. 4 finish .
12. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish .
 - b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.4 TRACTION SYSTEMS

- A. Fluid for Hydraulic Buffers: Fire-resistant fluid.
- B. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 05 50 00 "Metal Fabrications" for materials and fabrication.
- C. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Auxiliary Operations:
 1. Service: Service is initiated by a card reader at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in

SECTION 14 21 23.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

14 21 23.16 - 3

independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

- C. Security features shall not affect emergency firefighters' service.
 - 1. Card-Reader Operation: System uses card readers at car-control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Allow space for card reader in car .
 - a. Security access system equipment is specified in Section 28 15 00 "Access Control Hardware Devices."

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. Provide enameled or powder-coated steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 - 1. Enameled or Powder-Coated Steel Wall Panels: Flush, formed-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
 - 2. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
 - 3. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet or by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - 4. Sight Guards: Provide sight guards on car doors.
 - 5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
 - 6. Luminous Ceiling: LED light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
 - 7. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
 - 1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
 - 1. Fire-Protection Rating: 1 hour 1-1/2 hours .
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
 - 1. Enameled or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
 - 2. Stainless Steel Frames: Formed from stainless steel sheet.
 - 3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches high, on both jambs of hoistway door frames.
 - 4. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet or by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - 5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
 - 6. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed or semirecessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 - 1. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems."
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing .
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
 - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 - 2. Units mounted in both jambs of entrance frame for each elevator.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- I. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.
- J. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- K. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Stainless Steel Bars: ASTM A276, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
- F. Aluminum Extrusions: ASTM B221, Alloy 6063.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- B. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- C. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.
- D. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- E. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - 2. Place hall lanterns either above or beside each hoistway entrance.
 - 3. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

3.3 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 3. Engage elevator Installer to provide full maintenance service.
 - 4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity.

END OF SECTION 14 21 23.16

SECTION 14 91 82 - TRASH CHUTES

PART 1 - Part 1 GENERAL

1.1 1.1 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Work Included: Furnish and install where shown on plans 24" diameter trash chute as manufactured by Wilkinson-Hi-Rise, as specified below.

1.3 SUBMITTALS

- A. Catalog Cuts: Before the trash chute is delivered to the job site, submit catalog cuts to the Architect in accordance with these specifications, showing all details of installation and assembly and all requirements for work by other trades.
- B. Product Data: Manufacturer's product specifications, standard details and recommendations for project conditions; indicate selected sizes and installation details specific to the project.
- C. Shop Drawings:
 - 1. Plans: Scale 1/4 inch to 1 foot; indicate locations, dimensions, and required associated construction activities.
 - 2. Elevations/Sections: Scale 1/4 inch to 1 foot; indicate locations, dimensions, and required associated required construction activities.
 - 3. Details: Scale 1/4 inch to 1 foot; indicate:
 - a. Shop drawings specific to project conditions
 - b. Interface with adjacent construction
 - c. Dimensions and tolerances
 - d. Products required for installation of the trash chute, but not supplied by trash chute manufacturer.
- D. Quality Assurance/Control Submittals:
 - 1. Contractor's Certification that:
 - a. Products of this section are manufactured by Wilkinson-Hi-Rise.
 - b. Manufacturer's certification that installer of manufacturer's product is approved.
 - c. Applicable standards: National Fire Protection Association
1) (NFPA.82.1999), standards as referenced herein.
- E. Close-out Submittals:
 - 1. Operation and Maintenance Data.

2. Warranty Documents: Issued and executed by the manufacturer and installer of the system.

1.4 1.5 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Minimum five (5) years-documented experience producing products specified in this section.
2. Installer: Approved by the Manufacture, and having a minimum of five (5) years experience.

B. Pre-Installation Meetings:

1. Convene at job site a minimum of seven (7) calendar days prior to scheduled beginning of construction activities of this section to review requirements of this section.
2. Require attendance by representatives of the following:
 - a. Trash chutes manufacturer or designated representative
 - b. Installer of this section
 - c. Other entities directly affecting, or affected by, construction activities of this section.
 - d. Notify Architect four (4) calendar days in advance of scheduled meeting date.

1.5 RELATED WORK BY OTHERS SPECIFIED ELSEWHERE

A. The following work is excluded from the scope of work in this section 11175 and is included in other divisions of the specifications for inclusion in the scope of work of others.

1. Flashing at the roof
2. Water supply and valves to flushing and fire sprinkler heads
3. Switch assembly, conduit and/or wiring to solenoid valve for the disinfecting and sanitation unit located behind a plumbing access door directly above the highest intake door.
4. Installation of the plumbing access door provided under this section is to be by the forces erecting the shaft enclosure walls.

1.6 1.7 WARRANTY

A. Manufacturer's warranty: Furnish manufacturer's standard one (1) year warranty from date of temporary certificate of occupancy or similar, locally mandated permission to use the project common areas for their intended use. Warranty shall apply to defects in product workmanship and materials.

PART 2 - Part 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers: Wilkinson-Hi-Rise, 3001 Greene Street, Hollywood, FL 33020
Telephone: (800) 231-3888.
- B. Substitutions: Only products approved by the architect will be acceptable. Submit the following listed items (2-5) with proper documentation as required for substitution requests. Allow an additional (15) working days for any substitution review in addition to the standard review time for submittals.
- C. Request for substitutions must follow the requirements in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.
- D. Components:
 - 1. The chute shall be 24" diameter of U.S. #16 gauge galvanized or aluminized steel as manufactured by Wilkinson-Hi-Rise.
 - 2. Intakes Door: Stainless steel, 15 inches wide x 18 inches high, bottom hinged, hand operated self-closing positive latching doors bearing 1½ hour, Underwriters Laboratories "B" Label designation and rated for a 250° F maximum door temperature rise over 30 minutes, with stainless steel trim in a UL® approved, "B" Label, 1½ hour assembly.
 - 3. Discharge: Wilkinson, U.S. #16 gauge galvanized or aluminized steel type "A" open end chute discharge rolling steel door with 165°F. fusible link hold open on an inclined steel track at the bottom of the chute to close automatically when the ambient temperature reaches 165°F. as required by city or state building and/or fire codes.
 - 4. Vent: Chute shall extend full diameter through roof to metal top vent cap
 - 5. 4'-0" above roof level with counter flashing and insect screen. A roof curb (44"x 44" x minimum of 8" high) is required for flat roof conditions and is to be provided by others.
 - 6. Accessories: 3/4 inch IPS flushing spray head and 1/2 inch sprinkler head above highest intake. Additional 1/2-inch sprinkler heads at every second intake (counting from the top) or as required by local code.
 - 7. Provide Disinfecting & Sanitizing unit for installation in line to the flushing spray head. Connection to flushing spray head, back flow prevention valve and electric control switch by others.
 - 8. 7. Provide 15 inches wide x 15 inches high right side hinged, hand operated, self closing, positive latching, UL 1 1/2-hour. "B" labeled, stainless steel plumbing access door having stainless steel door trim for installation by forces erecting enclosing shaft wall. Door to have master keyed lock. Cylinder provided by others. Door for access to disinfecting & sanitizing unit above the highest intake door of the chute.
 - 9. Offsets (bends) in the chute, if required, shall be made the same diameter as the chute of #16 US gauge aluminized steel and have an additional layer of # 13 US gauge aluminized steel reinforcing the impact area. Offsets are not to deviate more than 15o off the vertical axis of the chute.
 - 10. Provide Daubert 932 sound coat (or equal) vibration dampening compound to the exterior of the chute only. Include Korfund sound isolator pads at each floor support frame.
 - 11. Sprinkler System: Chute shall be protected internally by automatic sprinklers. This requires a sprinkler at or above the top intake door of the chute, and in addition, a

sprinkler shall be installed within the chute at alternate floor levels in building over two stories in height with mandatory sprinkler located at the lowest service level.

2.2 2.2 FABRICATION

- A. The trash chute shall be fully factory assembled and all joints, except those required to separate the sections for shipment and installation shall be welded or lock-seamed tight. The floor intake doors shall be bolted in place on throats formed into the chute. All chute sections shall flash inside the sections below and there shall be no bolts, clips, or other projections inside the chute to snag the flow of material. Pre-positioned support frames shall assure proper intake levels and there shall be an expansion joint in the chute between all support joints. Discharge hoppers and offsets, where required, shall be reinforced and separately supported in the impact area.

PART 3 - Part 3 EXECUTION

3.1 3.1 EXAMINATION

- A. Verification of conditions:
 - 1. Area in which system is to be located is correct size and location, and is prepared for installation of trash chute and components.
- B. Installer's examination:
 - 1. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if conditions under which construction activities of this section are to be performed are unacceptable.
 - 2. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
 - 3. General Contractor shall verify and record chute alignment with installer immediately following installation.

3.2 3.2 INSTALLATION

- A. Install trash chute in accordance with shop drawings and manufacturer's printed installation instructions.

3.3 3.3 DEMONSTRATION

- A. Arrange demonstration of system operation, conducted by manufacturer's representative, to Owner's maintenance personnel.

END OF SECTION 14 91 82

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to

ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends and a welded steel water stop, unless otherwise indicated.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.

- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with setscrew.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings

below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
- 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections

specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210500

SECTION 211313 - SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. SECTION INCLUDES:
 - 1. Wet pipe sprinkler system.
 - 2. System design, installation, and certification.
 - 3. Fire department connections.
- B. RELATED SECTIONS
 - 1. Division 2 - Trenching.
 - 2. Section 15070 - Vibration Isolation.
 - 3. Section 15075 - Mechanical Identification.
 - 4. Section 16150 - Wiring Connections.

1.2 REFERENCES

- A. NFPA 13 - Installation of Sprinkler Systems.
- B. FM - Factory Mutual Approval Guide.
- C. NFPA 70 - National Electrical Code.
- D. UL - Fire Resistance Directory.
- E. UL 199 - Automatic Sprinklers.

1.3 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.
- B. Provide system to NFPA 13R light hazard.
- C. Determine volume and pressure of incoming water supply from water flow test data. Coordinate with site engineer.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections. Coordinate location with project engineer and local fire department.

1.4 SUBMITTALS FOR REVIEW

- A. Division 1 - Submittals: Procedures for submittals.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

- C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation. Design engineer shall coordinate layout of all sprinkler heads with project architect and engineer.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- D. Submit shop drawings, product data, and hydraulic calculations to engineer for approval, authority having jurisdiction for approval, Owner's insurance underwriter for approval. Submit proof of approval to Engineer.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 1 - Contract Closeout: Operation and Maintenance Data, Warranties: Procedures for submittals.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds all NFPA, L&I and BOCA code requirements.
- D. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- D. Design entire system under direct supervision of a NICET certified sprinkler designer or registered engineer experienced in design of this Work.

1.7 REGULATORY REQUIREMENTS

- A. Conform to UL and FM.
- B. Perform Work in accordance with NFPA 13.
- C. Equipment and Components: Bear UL or FM label or marking.

- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 PRE-INSTALLATION MEETING

- A. Division 1 - Coordination and Meetings: Pre-installation meeting.
- B. Convene two weeks before starting work of this section.

1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.
- B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 EXTRA MATERIALS

- A. Division 1 - Contract Closeout, Operation and Maintenance Data.
- B. Provide extra sprinklers under provisions of NFPA 13.
- C. Provide suitable wrenches for each sprinkler type.
- D. Provide metal storage cabinet adjacent to alarm valve.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. GEM.
- B. Other Acceptable Manufacturers:
 - 1. Central.
 - 2. Star.
- C. Division 1 - Material and Equipment: Product options Substitutions: Not permitted.

2.2 SPRINKLERS

- A. Suspended Drywall or Lay-In Ceiling:
 - 1. Manufacturers:
 - a. GEM Model F976.
 - b. Equal by Central.
 - c. Equal by Star.
 - 2. Type: Concealed pendant type.
 - 3. Finish: Enamel cap color by Architect.
 - 4. Fusible Link: Fusible solder link, temperature rated for specific area hazard (165 degrees min.). Provide 212 degree solder links in areas not air conditioned and in accordance with the NFPA 13.
- B. Exposed Area Type:
 - 1. Manufacturers:

- a. GEM Model F950.
 - b. Equal by Central.
 - c. Equal by Star.
- 2. Type: Standard upright type with guard.
- 3. Finish: Brass.
- 4. Fusible Link: Fusible solder link with temperature rated for specific area hazard (165 degrees min.). Provide 212 degree solder links in areas not air conditioned in accordance with NFPA 13, and where shown on the drawings.
- C. Sidewall Type:
 - 1. Manufacturers:
 - a. GEM Model F950.
 - b. Equal by Central.
 - c. Equal by Star.
 - 2. Type: Standard horizontal sidewall type with matching push on escutcheon plate and guard.
 - 3. Finish: Chrome plated.
 - 4. Escutcheon Plate Finish: Chrome plated.
 - 5. Fusible Link: Fusible solder link type with temperature rated for specific area hazard (165 degrees min.). Provide 212 degree solder links in areas not air conditioned in accordance with NFPA 13, and where shown on the drawings.

2.3 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim with test and drain valve. GEM F20 or equal.
- B. Electric Alarm: Per fire alarm engineer.
- C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts.
- D. Fire Department Connections:
 - 1. Type: Flush mounted wall type with brass finish.
 - 2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - 3. Drain: 3/4 inch automatic drip.
 - 4. Label: "Sprinkler/Standpipe - Fire Department Connection".
- E. Supervisory Switches: As manufactured by GEM or equal. Provide flow switches for each system and on a floor-by-floor basis for sprinkler system. Provide tamper switches on all valves.
- F. Double detector check with bypass meter. Watts 709DCDA.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. Install equipment in accordance with manufacturer's instructions.

- C. Provide approved double check valve backflow preventer with bypass meter assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- E. Place pipe runs to minimize obstruction to other work.
- F. Place piping in concealed spaces above finished ceilings.
- G. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- H. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting.
- I. Flush entire piping system of foreign matter.
- J. Install guards on exposed sprinklers (refer to drawings for specific locations).
- K. Hydrostatically test entire system.
- L. Require test be witnessed by authority having jurisdiction.
- M. Provide a working drain for all inspector's test locations.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

3.3 SCHEDULES

- A. System Hazard Areas – Refer to drawings.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Plumbing demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or

ring type, unless otherwise indicated.

- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.

- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.
 - e. Insert manufacturer's name.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:

- a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends and a welded steel water stop, unless otherwise indicated.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with setscrew.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:

- a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible-hose packless expansion joints.
 - 2. Metal-bellows packless expansion joints.
 - 3. Rubber packless expansion joints.
 - 4. Grooved-joint expansion joints.
 - 5. Pipe loops and swing connections.
 - 6. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.

- D. Product Certificates: For each type of expansion joint, from manufacturer.
 - E. Maintenance Data: For expansion joints to include in maintenance manuals.
- 1.5 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex Pression Ltd.
 - d. Metraflex, Inc.
 - e. Unisource Manufacturing, Inc.
 - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 - 4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - 6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Stainless-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
- B. Metal-Bellows Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adscos Manufacturing LLC.
 - b. American BOA, Inc.
 - c. Badger Industries, Inc.
 - d. Expansion Joint Systems, Inc.
 - e. Flex-Hose Co., Inc.
 - f. Flexicraft Industries.
 - g. Flex Pression Ltd.
 - h. Flex-Weld, Inc.
 - i. Flo Fab inc.
 - j. Hyspan Precision Products, Inc.
 - k. Metraflex, Inc.
 - l. Proco Products, Inc.
 - m. Senior Flexonics Pathway.
 - n. Tozen Corporation.
 - o. Unaflex.
 - p. Unisource Manufacturing, Inc.
 - q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
 - r. U.S. Bellows, Inc.
 - s. WahlcoMetroflex.
 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 3. Type: Circular, corrugated bellows with external tie rods.
 4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
 5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
 6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
 - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
- C. Rubber Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Flex-Weld, Inc.
 - e. Garlock Sealing Technologies.
 - f. General Rubber Corporation.
 - g. Mason Industries, Inc.; Mercer Rubber Co.
 - h. Metraflex, Inc.
 - i. Proco Products, Inc.
 - j. Red Valve Company, Inc.
 - k. Tozen Corporation.
 - l. Unaflex.
 - m. Unisource Manufacturing, Inc.
2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalies, or Chemicals: EPDM.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: CR.
11. Material for Water: BR.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 GROOVED-JOINT EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Anvil International, Inc.
 2. Shurjoint Piping Products.
 3. Victaulic Company.
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: Five, flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adscro Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Senior Flexonics Pathway.
 - i. Unisource Manufacturing, Inc.
 - j. U.S. Bellows, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.
- D. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
 - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: **[EPDM-rubber] [NBR]** interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: **[Carbon steel] [Plastic] [Stainless steel]**.
 - 3. Connecting Bolts and Nuts: **[Carbon steel, with corrosion-resistant coating,] [Stainless steel]** of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide **1-inch** annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With **[polished, chrome-plated]** **[and]** **[rough-brass]** finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With **[polished, chrome-plated]** **[and]** **[rough-brass]** finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, **[concealed]** **[and]** **[exposed-rivet]** hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange[**with holes for fasteners**].

- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass[**or split-casting brass**] type with [polished, chrome-plated] [rough-brass] finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass[**or split-casting brass**] type with [polished, chrome-plated] [rough-brass] finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with [concealed] [or] [exposed-rivet] hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with [concealed] [or] [exposed-rivet] hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with [concealed] [or] [exposed-rivet] hinge.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with [polished, chrome-plated] [rough-brass] finish.

- h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with **[concealed]** **[or]** **[exposed-rivet]** hinge.

- i. Bare Piping in Equipment Rooms: Split-casting brass type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-rivet**] hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220523 - PLUMBING VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Swing check valves.
 - 4. Spring loaded check valves.
 - 5. Water pressure reducing valves.
 - 6. Relief valves.
 - 7. Flanges, unions, and couplings.
- B. Related Sections:
 - 1. Section 230529 - Hangers and Supports: Product and installation requirements for pipe hangers and supports.
 - 2. Section 230700 - Mechanical Insulation: Product and installation requirements for insulation for piping and valves.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.
- B. American Society of Mechanical Engineers:
 - 1. ASME Section IV - Boiler and Pressure Vessel Code - Heating Boilers.
 - 2. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 67 - Butterfly Valves.
 - 2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - 6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 - 7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.

- C. Welders Certificate: Include welders certification of compliance with ASME Section IX.
- D. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with all local codes and standards.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements.

1.9 WARRANTY

- A. Division 1 - Execution Requirements: Product warranties and product bonds.
- B. Furnish 1 year manufacturer warranty for valves excluding packing.

1.10 EXTRA MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.

- B. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.1 PLUMBING VALVES

A. Ball Valves:

1. Manufacturers:
 - a. Nibco.
 - b. Watts.
 - c. Apollo.
 - d. Substitutions: Division 1 - Product Requirements.
2. Furnish materials in accordance with local codes and standards.
3. 2" and Smaller: MSS SP 110, Class 150, 600 psi bronze, two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends.

B. Butterfly Valves:

1. Manufacturers:
 - a. Nibco.
 - b. Watts.
 - c. Stockham.
 - d. Substitutions: Division 1 - Product Requirements.
2. Furnish materials in accordance with all local codes and standards.
3. 2-1/2" and Larger: MSS SP 67, 200 psi, cast or ductile iron body. Nickel-plated ductile iron disc, resilient replaceable EPDM seat, grooved ends, extended neck, infinite position lever handle with memory stop. Furnish gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

C. Swing Check Valves:

1. Manufacturers:
 - a. Nibco.
 - b. Watts.
 - c. American Valve.
 - d. FMC Crosby Valve.
 - e. Substitutions: Division 1 - Product Requirements.
2. Furnish materials in accordance with all local codes and standards.
3. 2 inches and Smaller: MSS SP 80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.
4. 2-1/2 inches and Larger: MSS SP 71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged ends.

D. Spring Loaded Check Valves:

1. Manufacturers:
 - a. Nibco.
 - b. Watts.
 - c. Substitutions: Division 1 - Product Requirements.

2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.
- E. Water Pressure Reducing Valves:
 1. Manufacturers:
 - a. Watts.
 - b. Substitutions: Division 1 - Product Requirements.
 2. 2 inches and Smaller: Construction: MSS SP 80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, and single union ends.
 3. 2-1/2 inches and Larger: MSS SP 85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.
- F. Relief Valves:
 1. Pressure Relief:
 - a. Manufacturers:
 - 1) Watts.
 - 2) Substitutions: Division 1 - Product Requirements.
 - b. Construction: AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
 2. Temperature and Pressure Relief:
 - a. Manufacturers:
 - 1) Watts.
 - 2) Substitutions: Division 1 - Product Requirements
 - b. Construction: ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME Section IV certified and labeled.

2.2 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe 2 inches and Smaller:
 1. Ferrous Piping: 150 psig malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 inches and Larger:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Copper Piping: Bronze.
- C. Gaskets: 1/16-inch thick preformed neoprene.
- D. Accessories: Steel bolts, nuts, and washers.
- E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination with project conditions.
- B. Verify piping system is ready for installation.

3.2 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Use grooved mechanical couplings and fasteners only in accessible locations.
- D. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- E. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- F. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Use lug end butterfly valves to isolate equipment.
- I. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- J. Provide plug valves in natural gas systems for shut-off service.
- K. Provide flow controls in water re-circulating systems as indicated on Drawings.
- L. Refer to Section 230700 for insulation requirements for piping and valves.
- M. Refer to Section 230529 for pipe hangers.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Sleeves.
 - 6. Mechanical sleeve seals.
 - 7. Firestopping relating to mechanical work.
 - 8. Firestopping accessories.
 - 9. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 230548 - Mechanical Sound, Vibration, and Seismic Control: Product and execution requirements for vibration isolators.
 - 2. Section 232113 - Heating and Cooling Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.9 - Building Services Piping.
- B. American Society for Testing and Materials:
 - 1. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Factory Mutual System:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

Northview Heights Midrise Development

Fukui Architects Project #2040

PFHA Project No. 2021-156

February 9, 2022 Construction Set

- G. Warnock Hersey:
 - 1. WH - Certification Listings.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction.
- B. Surface Burning: ASTM E84, UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with all local codes and standards.
- B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 WARRANTY

- A. Division 1 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. B-Line.
 - 2. Grinnell.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Furnish materials in accordance with all applicable codes and standards.
- C. Plumbing Piping - DWV:
 - 1. Conform to ASME B31.9; ASTM F708.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
- D. Plumbing Piping - Water:
1. Conform to ASME B31.9; ASTM F708.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 11. Vertical Support: Steel riser clamp.
 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Copper-plated, Carbon-steel ring.
- E. Copper Pipe Support: Copper-plated carbon-steel ring.

2.2 ACCESSORIES

- A. Hanger Rods: Steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Manufacturers:
1. Grinnell.
 2. B-line.
 3. Substitutions: Division 1 - Product Requirements.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. Refer to roofing specifications.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. 3M fire Protection Products.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Furnish materials in accordance with all local codes and standards.
- C. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve, link-seal or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Verification of existing conditions before

starting work.

- B. Verify openings are ready to receive sleeves.

- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Engineer before using powder-actuated anchors.
- D. Do not drill or cut structural members.
- E. Obtain permission from Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1; ASME B31.5; ASME 31.9; ASTM F708.
- B. Support horizontal piping as scheduled. If not scheduled, support in accordance with the International Mechanical Code.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 230700.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4" thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 230548.

3.6 INSTALLATION – FLASHING

- A. All roof work shall be performed in strict accordance with the roofing contractor's requirements. On new or warranted work MC shall pay the roofing contractor to perform all of his roof work.
- B. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- C. Flash vent and soil pipes projecting 12 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- D. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- E. Seal floor drains watertight to adjacent materials.
- F. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- G. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- H. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe

or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

- F. Install stainless steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where conduit, and penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

3.9 FIELD QUALITY CONTROL

- A. Division 1 - Quality Requirements, 014000 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

- A. Division 1 - Execution Requirements: Requirements for cleaning.

- B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Division 1 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

PIPE HANGER SPACING – Steel, Cast Iron or Copper Unless Noted.

<u>PIPE SIZE</u> (Inches)	<u>MAX. HANGER SPACING</u> (Feet)	<u>HANGER ROD DIAMETER</u> (Inches)
1/2	8	3/8
3/4	8	3/8
1	8	3/8
1-1/4	8	3/8
1-1/2	10	3/8
2	10	3/8
2-1/2	12	1/2
3	12	1/2
4	12	5/8
5	12	5/8
6	12	3/4
8	12	3/4
10	12	7/8
12	12	7/8
Spigot or No-Hub And at Joints	5	5/8

END OF SECTION 230529

SECTION 220553 - PLUMBING IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Samples: Submit tags, labels, pipe markers, and size used on project.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience approved by manufacturer.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 EXTRA MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Furnish materials in accordance with local codes and standards.
- C. Product Description: Laminated three-layer plastic with engraved letters on light contrasting background color.

2.2 TAGS

- A. Metal Tags:
 - 1. Manufacturers:
 - a. Seton.
 - b. Brady.
 - c. Substitutions: Refer to Division 1 - Product Requirements.
 - 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- B. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.3 STENCILS

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Furnish materials in accordance with all local codes and standards.
- C. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.

2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Ductwork and Equipment: 1-3/4 inches high letters.

- D. Stencil Paint: As specified in Division 9, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
1. Manufacturers:
 - a. Seton.
 - b. Brady.
 - c. Substitutions: Refer to Division 1 - Product Requirements.
 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
1. Manufacturers:
 - a. Seton.
 - b. Brady.
 - c. Substitutions: Refer to Division 1 - Product Requirements.
 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install tags using corrosion resistant chain. Number tags consecutively by location.
- D. Identify equipment with plastic nameplates. Identify in-line pumps and other small devices with tags.
- E. Identify control panels and major control components outside panels with plastic nameplates.
- F. Identify valves in main and branch piping with tags.
- G. Identify air terminal units and radiator valves with numbered tags.
- H. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with

axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

- I. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Domestic chilled-water piping for drinking fountains.
 - 5. Sanitary waste piping exposed to freezing conditions.
 - 6. Storm-water piping exposed to freezing conditions.
 - 7. Roof drains and rainwater leaders.
 - 8. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Sustainable Design Submittals:
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Jacket Materials for Pipe: 12 inches long by NPS 2.
3. Sheet Jacket Materials: 12 inches square.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 2. For each mockup, fabricate cutaway sections to allow observation of application details

- for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.

4. Obtain Architect's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.
- D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heattracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less

than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Block Insulation: ASTM C 552, Type I.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 4. Preformed Pipe Insulation with Factory-Applied **[ASJ]** **[ASJ-SSL]**: Comply with ASTM C 552, Type II, Class 2.
 - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, **[without factory-applied jacket]** **[with factory-applied ASJ]** **[with factory-applied ASJ-SSL]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Phenolic:
 - 1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - 2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - 3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 4. Factory-Applied Jacket: **[None]** **[ASJ]**. Requirements are specified in "Factory-Applied Jackets" Article.
- K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F .
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
- F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg.
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 2. Service Temperature Range: 0 to 180 deg F.
 - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 4. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: 60 percent by volume and 66 percent by weight.
 - 4. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

- A. Joint Sealants for Cellular-Glass and Phenolic Products:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 4. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Adhesive: As recommended by jacket material manufacturer.
 - 2. Color: **[White] [Color-code jackets based on system. Color as selected by Architect].**
 - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
 - 1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].**
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **1-mil- thick, heat-bonded polyethylene and kraft paper 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn].**
 - d. Moisture Barrier for Outdoor Applications: **3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn.**
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - 2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A240M.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].**
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **1-mil- thick, heat-bonded polyethylene and kraft paper 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn.**
 - d. Moisture Barrier for Outdoor Applications: **3-mil- thick, heat-bonded polyethylene and kraft paper]2.5-mil- thick polysurlyn.**
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

- 3) Tee covers.
- 4) Flange and union covers.

- 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJtape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSKtape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
 2. Thickness: 6 mils .
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500 percent.
 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
 2. Thickness: 3.7 mils.
 3. Adhesion: 100 ounces force/inch in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches 4 inches** o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve

- stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF POLYOLEFIN INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, [three] locations of threaded valves, and [three] locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. **NPS 1** and Smaller: Insulation shall be **one of** the following:
 - a. Flexible Elastomeric: **1 inch** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type **1** **inch** thick.
 - c. Phenolic: **1 inch** thick.
 - d. Polyolefin: **1 inch** thick.
2. **NPS 1-1/4** and Larger: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Polyolefin **inch** thick.

B. Domestic Hot and Recirculated Hot Water:

1. **NPS 1-1/4** and Smaller: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Phenolic: **1 inch** thick.
 - c. Polyolefin: **1 inch** thick.
2. **NPS 1-1/2** and Larger: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Phenolic: **1 inch** thick.
 - c. Polyolefin: **1 inch** thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Phenolic: **1 inch** thick.
 - c. Polyolefin: **1 inch** thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Phenolic: **1 inch** thick.
 - c. Polyolefin: **1 inch** thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Phenolic: **1 inch** thick.
 - c. Polyolefin: **1 inch** thick.

F. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be **[one of]** the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
 - b. Phenolic: **1 inch** thick.
 - c. Polyolefin: **1 inch** thick.

END OF SECTION 220719

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.

1.3 DEFINITIONS

- A. DICL: Ductile Iron Cement Lined

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of Huntingdon Borough Water Authority. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of Huntingdon Borough Water Authority for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of Huntingdon Borough Water Authority and any applicable Code Agency for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for

intended use.

- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Available Manufacturers:
 - 1. Griffin Pipe
 - 2. US Pipe
 - 3. McWane Ductile
- B. All ductile iron pipe shall be cement lined inside and outside with a bituminous seal coat in accordance with AWWA C104.
- C. Mechanical Restrained-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. "Field Lok" restrained joint gaskets, or equal.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - d. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - e. JCM Industries.
 - f. Smith-Blair, Inc.
 - g. Viking Johnson.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.
 - b. Center-Sleeve Material: Manufacturer's standard.
 - c. Gasket Material: Natural or synthetic rubber.
 - d. Pressure Rating: 200 psig minimum.
 - e. Metal Component Finish: Corrosion-resistant coating or material.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Available Manufacturers:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. Equal.
2. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers:
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. U.S. Pipe and Foundry Company.
2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable

extension of length required for depth of burial of valve, plug with lettering "WATER" for domestic water lines and "FIRE" for all designated fire lines, and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.6 CORPORATION VALVES and CURB VALVES

A. Manufacturers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - b. Mueller Co.; Water Products Div.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER" and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.

2.7 WATER METERS

A. Water meters as per Huntingdon Borough Water Authority requirements.

B. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sensus Metering Systems: Omni Meter

2.8 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the

following:

- a. FEBCO; SPX Valves & Controls.
 - b. Equal.
 2. Standard: AWWA C511.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 5. Size: As per Huntingdon Borough Water Authority requirements.
- B. Double-Check, Backflow-Prevention Assemblies:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Water Technologies, Inc.
 2. Standard: AWWA C510.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Size: As per Huntingdon Borough Water Authority requirements.

2.9 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
1. Size: As per Huntingdon Borough Water Authority requirements.

2.10 FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Co.; American Darling Valve, Model B-62-B, Traffic Model.
 2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standard: AWWA C502.
 - b. Pressure Rating: 200 psig minimum.
 - c. Outlet Threads: NFPA 1963, with National Standard threads. Include cast-iron caps with steel chains.
 - d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.

- e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
- f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Comply with NFPA 24 for fire-service-main piping materials and installation.
- C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- D. Bury piping with depth of cover as shown on the Drawings.
- E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- H. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.
- I. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.3 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and

restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
 2. Set-screw mechanical retainer glands.
 3. Bolted flanged joints.
 4. Heat-fused joints.
 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.6 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to HUNTINGDON BOROUGH WATER AUTHORITY instructions.

3.7 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of HUNTINGDON BOROUGH WATER AUTHORITY.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.8 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.9 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. In accordance with HUNTINGDON BOROUGH WATER AUTHORITY procedures.
- B. Hydrostatic Tests: In accordance with HUNTINGDON BOROUGH WATER AUTHORITY procedures.
- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground detectable warning tape with 16-gauge trace wire during backfilling of trench for all underground water-distribution piping. It shall be bright blue in color, continuously printed ribbon tape of not less than two (2") inches wide X four (4) mil thick for all service lines and six (6") inches wide for all lines six (6") inches or greater in diameter. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. In accordance with HUNTINGDON BOROUGH WATER AUTHORITY procedures. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe and pipe fittings.
 - 2. Domestic water piping system.
- B. RELATED SECTIONS
 - 1. Section 230529 – Hangers and Supports.
 - 2. Section 230548 - Vibration Isolation.
 - 3. Section 230700 - Piping Insulation.
 - 4. Section 224000 - Plumbing Fixtures.
 - 5. Section 224010 - Plumbing Specialties.
 - 6. Division 31 – Excavating, Earthwork, Trenching.
 - 7. Division 8 - Access Doors.
 - 8. Division 9 - Painting.

1.2 REFERENCES

- A. Division 1 - Quality Control
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B16.22 - Wrought Copper and Bronze Solder Joint Pressure Fittings.
- D. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- E. ASME B31.9 - Building Service Piping.
- F. ASME SEC IV - Construction of Heating Boilers.
- G. ASME SEC IX - Welding and Brazing Qualifications.
- H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- I. ASTM B32 - Solder Metal.
- J. ASTM B42 - Seamless Copper Pipe.
- K. ASTM B75 - Seamless Copper Tube.
- L. ASTM B88 - Seamless Copper Water Tube.
- M. ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- N. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- O. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

- P. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- Q. AWWA C651 - Disinfecting Water Mains.
- R. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include installation instructions, spare parts lists.

1.5 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state regulations.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years' experience.
- B. Installer: Company specializing in performing the work of this section with minimum 3 years' experience.

1.7 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with the latest edition of the, BOCA, NFPA and all local codes.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 COLD WATER PIPING, ABOVE GRADE

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40

- 1. Fittings:
 - a. CPVC: Socket fittings, ASTM F 438 for Schedule 40
 - B. Pex Piping is acceptable within units.
- 2.2 HOT WATER PIPING, ABOVE GRADE
- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40
 - 1. Fittings:
 - a. CPVC: Socket fittings, ASTM F 438 for Schedule 40
 - B. Pex Piping is acceptable within units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations under provisions of Division 1.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Establish elevations of buried piping outside the building to ensure not less than 4 ft of cover for water lines.
- I. Provide support for utility meters in accordance with requirements of utility companies.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9.

- K. Excavate and backfill in accordance with Division 2.
- L. Install water piping to ASME B31.9.
- M. Install foundation drain bedded in a gravel envelope. Gravel bedding shall extend 4" above top of tubing and 4" below bottom of tubing. Install drain line with continuous fall of 0.25" per foot. Use non-perforated tubing for sections where tree roots may be present. Provide geotextile fabric around entire filter bed. Refer to architectural and site engineering documents.

3.4 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage per code or as noted on the drawings.
- B. Slope water piping and arrange to drain at low points.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.6 SERVICE CONNECTIONS

- A. Provide new water and fire service complete with approved reduced pressure backflow preventer. Water meter assembly to be provided by and installed by Pennsylvania-American Water Company. Coordinate service requirements with the local utilities. Pay all permitting fees.
 - 1. Provide sleeve in wall or floor for service main. Caulk enlarged sleeve and make watertight with pliable material such as link-seal. Anchor service main.
- B. All new services shall be coordinated with the local utility companies. Contractor shall pay all permitting fees. Owner will pay the water service tap and meter fee.

END OF SECTION 221116

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:
 - 1. Precast concrete manholes.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: **10-foot head of water** .

1.5 SUBMITTALS

- A. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers
- B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet . Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- C. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than three days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, 15" and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. PVC Sewer Pipe and Fittings, 18" and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- C. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.4 MANHOLES

- A. Designed Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
 - 1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
 - 2. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
 - 4. Steps: Individual FRP steps or FRP ladder wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole

to finished grade is less than 60 inches.

5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
6. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
7. Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint 10-mil minimum thickness applied to exterior and interior surfaces.
8. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
 - b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil minimum thickness applied to all surfaces, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 2. Use pressure-type pipe couplings for force-main joints.
- B. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range:
 1. 3": 4" PVC sewer pipe and fittings, gaskets, and gasketed joints.
 2. 4" : PVC sewer pipe and fittings, gaskets, and gasketed joints.
 3. 5" and 6": 6" cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
 4. 5" and 6": 6" PVC sewer pipe and fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

Where specific installation is not indicated, follow piping manufacturer's written instructions.

- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install 6" and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping below frost line.
 - 4. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.4 PIPE JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 22 Section "Common Work Results for Plumbing" Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketjoints.
 - 2. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Install FRP manholes according to manufacturer's written instructions.
- D. Form continuous concrete channels and benches between inlets and outlet.
- E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops **3 inches** above finished surface elsewhere, unless otherwise indicated.

- F. Install manhole cover inserts in frame and immediately below cover.

3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Make branch connections from side into existing piping, 4" to 20". Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.8 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Backfill to grade according to Division 31 Section "Earth Moving."

3.9 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
 6. Manholes: Perform hydraulic test according to ASTM C 969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

- A. Clean interior of piping of dirt and superfluous material.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe and pipe fittings.
 - 2. Sanitary waste and vent piping system.
- B. RELATED SECTIONS
 - 1. Section 230529 – Hangers and Supports.
 - 2. Section 230548 – Mechanical Sound, Vibration and Seismic Control.
 - 3. Section 230700 - Piping Insulation.
 - 4. Section 224000 - Plumbing Fixtures.
 - 5. Section 224010 - Plumbing Specialties.
 - 6. Division 31 – Excavating, Earthwork, Trenching.
 - 7. Division 8 - Access Doors.
 - 8. Division 9 - Painting.

1.2 REFERENCES

- A. Division 1 - Quality Control
- B. ASME B16.3 - Malleable Iron Threaded Fittings.
- C. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B16.22 - Wrought Copper and Bronze Solder Joint Pressure Fittings.
- F. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- H. ASME B31.9 - Building Service Piping.
- I. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- K. ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- L. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- M. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- N. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include installation instructions, spare parts lists.

1.5 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state regulations.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years' experience.
- B. Installer: Company specializing in performing the work of this section with minimum 3 years' experience.

1.7 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with the latest edition of the, BOCA, NFPA and all local codes.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. PVC Pipe: NSF-DWV, Schedule 40.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- A. PVC Pipe: NSF-DWV, Schedule 40.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded.

2.3 VENT PIPING, ABOVE GRADE

- A. PVC Pipe: NSF-DWV, Schedule 40.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations under provisions of Division 1.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Establish elevations of buried piping outside the building to ensure not less than 3 feet of cover for sanitary lines.
- H. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- I. Excavate and backfill in accordance with Division 2.
- J. Install bell and spigot pipe with bell end upstream.

3.4 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage per code or as noted on the drawings.

3.5 SERVICE CONNECTIONS

- A. Provide new sanitary sewer service. Coordinate service with the site engineer. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing. All piping buried under roadways shall be in conformance with local requirements.
- B. All new services shall be coordinated with the local utility companies. Contractor shall pay permitting fees. Owner shall pay the tap and connection fees.

END OF SECTION 221316

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. Related Sections include the following:

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Shop Drawings:
 - 1. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.
- D. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- a. Manufacturers:
- 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.
- D. Solvent Cement and Adhesive Primer:
 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Aboveground storm drainage piping 6" and smaller shall be the following:
 1. Cellular core PVC pipe, PVC socket fittings, and solvent-cemented joints.
- B. Underground storm drainage piping 6" and smaller shall be the following:
 1. Hubless cast-iron soil pipe and fittings; **[standard,]** **[and]** **[heavy-duty]** shielded, stainless-steel couplings; and coupled joints.

3.3 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

- G. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of

standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- H. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping 3" and smaller; 1 percent downward in direction of flow for piping 4" and larger.
 - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- J. Install engineered controlled-flow storm drainage piping in locations indicated.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Install ABS storm drainage piping according to ASTM D 2661.
- M. Install PVC storm drainage piping according to ASTM D 2665.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.

- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1-1/2" and 2": 60 inches with 3/8-inch rod.
 - 2. 3": 60 inches with 1/2-inch rod.
 - 3. 4" and 5": 60 inches with 5/8-inch rod.
 - 4. 6": 60 inches with 3/4-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1-1/2" and 2": 48 inches with 3/8-inch rod.
 - 2. NPS 3": 48 inches with 1/2-inch rod.
 - 3. NPS 4" and 5": 48 inches with 5/8-inch rod.
 - 4. NPS 6": 48 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- H. Install supports for vertical PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

**DOUGHBOY AFFORDABLE LIVING
3350 PENN AVENUE AND 3400 PENN AVENUE
PITTSBURGH, PENNSYLVANIA**

SECTION 221423 – STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
 - 1. Cleanouts.
 - 2. Roof drains.
 - 3. Miscellaneous storm drainage piping specialties.
 - 4. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
5. Size: Same as connected drainage piping
6. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
7. Closure: Countersunk or raised-head plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.36.2M for adjustable housing cleanout.
5. Size: Same as connected branch.
6. Type: Adjustable housing.
7. Body or Ferrule: Cast iron.
8. Clamping Device: Required.
9. Outlet Connection: Threaded.
10. Closure: Cast-iron plug.

11. Adjustable Housing Material: Cast iron.
12. Frame and Cover Material and Finish: Polished bronze.

13. Frame and Cover Shape: Round.
14. Top Loading Classification: Medium Duty.
15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.36.2M. Include wall access.
5. Size: Same as connected drainage piping.
6. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
7. Closure: cast-iron plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
9. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
10. Wall Access: Round wall-installation frame and cover.

D. Plastic Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
3. Size: Same as connected branch.
4. Body: PVC.
5. Closure Plug: PVC.
6. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 ROOF DRAINS

A. Metal Roof Drains (RD):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Portals Plus, Inc.
 - e. Prier Products, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.21.2M.
5. Pattern: Roof drain.
6. Body Material: Cast iron.
7. Combination Flashing Ring and Gravel Stop: Not required.
8. Flow-Control Weirs: Not required.
9. Outlet: Side.
10. Dome Material: Cast iron.
11. Extension Collars: Required.
12. Underdeck Clamp: Required.
13. Sump Receiver: Not required.

2.3 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials,

joint construction, and basic installation requirements.

- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to 4". Use 4" for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping 4" and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- F. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
 - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- G. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- H. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- I. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

- B. Set flashing on floors and roofs in solid coating of bituminous cement.

- C. Secure flashing into sleeve and specialty clamping ring or device.
- D. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221413

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.
 - 2. Wet-pit-volute sump pumps.
 - 3. Sump-pump basins and basin covers.
 - 4. Packaged drainage-pump units.
- B. Related Section:
 - 1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - 1. Description: Factory-assembled and -tested sump-pump unit.
 - 2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - 3. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - 4. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
 - 5. Seal: Mechanical.
 - 6. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Oil.
 - 7. Controls:
 - a. Enclosure: NEMA 250,
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - 8. Controls:
 - a. Enclosure: NEMA 250,
 - b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - 9. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

- 1) On-off status of pump.
 - 2) Alarm status.
- B. Submersible, Fixed-Position, Double-Seal Sump Pumps:
1. Description: Factory-assembled and -tested sump-pump unit.
 2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 3. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 4. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
 5. Seals: Mechanical.
 6. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 7. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
8. Controls:
- a. Enclosure: NEMA 250,
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
9. Controls:
- a. Enclosure: NEMA 250,.
 - b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
10. Control-Interface Features:
- a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.2 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
1. Material: Polyethylene
 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.

3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.3 PACKAGED DRAINAGE-PUMP UNITS

- A. Packaged Pedestal Drainage-Pump Units:
 1. Description: Factory-assembled and -tested, automatic-operation, freestanding, sump-pump unit.
 2. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 3. Pump Casing: Corrosion-resistant material, with strainer inlet, design that permits flow into impeller, and vertical discharge for piping connection.
 4. Impeller: Aluminum, brass, or plastic.
 5. Motor: With built-in overload protection and mounted vertically on sump pump column.
 6. Power Cord: Three-conductor, waterproof cable of length required but not less than 72 inches with grounding plug and cable-sealing assembly for connection at pump.
 7. Control: Float switch.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pumps and controls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 223300 – DOMESTIC WATERHEATERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Domestic Hot Water Heaters.
- B. RELATED SECTIONS
 - 1. Section 230548 – Mechanical Sound, Vibration, and Seismic Control.
 - 2. Section 262800 – Wiring Connections

1.2 REFERENCES

- A. ASHRAE 90A - Energy Conservation in New Building Design.
- B. Pennsylvania Code, Title 34, Labor and Industry, Chapter 3, Boilers and Unfired Pressure Vessels.
- C. NFPA 54 - National Fuel Gas Code.
- D. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

- A. Division 1 - Submittals: Procedures for submittals.
- B. Product Data:
 - 1. Provide electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions

1.4 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 1 - Contract Closeout: Operation and Maintenance Data, Warranties: Procedures for submittals.
- B. Project Record Documents: Record actual locations of components and equipment.
- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products

specified in this section with minimum three years documented experience.

- B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. American Gas Association (AGA).
 - 2. National Sanitation Foundation (NSF).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - 5. National Electrical Manufacturers' Association (NEMA).
 - 6. Underwriters Laboratories (UL).
 - 7. Latest edition of BOCA and all local codes.
- C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 WARRANTY

- A. Division 1 - Contract Closeout, Warranties.
- B. Provide five year manufacturer warranty for domestic water heaters and packaged water heating systems.

1.8 MAINTENANCE PRODUCTS

- A. Division 1 - Contract Closeout, Operation and Maintenance Data.

1.9 EXTRA MATERIALS

- A. Division 1 - Contract Closeout, Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 COMMERCIAL ELECTRIC DOMESTIC HOT WATER HEATERS

- A. Manufacturer: A.O. Smith
- B. Other acceptable manufacturers offering equivalent.
 - 1. State
- C. System: Electric/Heat Pump water heaters, controls, piping and valving as indicated.
- D. Heater:
 - 1. U.L. Listed.
 - 2. Heater Element – Element shall be a durable, stainless steel element.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install domestic hot water heaters in accordance with manufacturer's instructions and to AGA NSF NFPA 54 UL requirements.
- B. Coordinate electrical work to achieve operating system.
- C. Domestic Hot Water Heaters:
 - 1. Clean and flush after installation. Seal until pipe connections are made.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. ADA water closets.
 - 3. Urinals.
 - 4. Lavatories.
 - 5. Sinks.
 - 6. Mop Sinks.
 - 7. Water Coolers.
- B. RELATED SECTIONS
 - 1. Division 12 – Manufactured Laminate Factory Casework.
 - 2. Division 7 - Joint Sealers: Sealfixtures to walls and floors.
 - 3. Section 230529 – Hangers and Supports.
 - 4. Section 221116 – Domestic Water Piping.
 - 5. Section 221316 – Sanitary Waste and Vent Piping.
 - 6. Section 224010 - Plumbing Specialties.
 - 7. Section 262800 - Wiring Connections.
 - 8. Division 10 - Toilet and Bath Accessories: Product requirements for integral lavatory counter tops for placement by this Section.

1.2 REFERENCES

- A. ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

1.3 SUBMITTALS FOR REVIEW

- A. Division 1 - Submittals: Procedures for submittals.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.4 SUBMITTALS FOR INFORMATION

- A. Division 1 - Submittals: Procedures for submittals.
- B. Manufacturer's Instructions: Indicate installation methods and procedures.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 1 - Contract Closeout: Operation and Maintenance Data, Warranties: Procedures for submittals.

- B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 WARRANTY

- A. Division 1 - Contract Closeout, Warranties.

1.10 EXTRA MATERIALS

- A. Division 1 - Contract Closeout, Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 WATER CLOSETS

- A. Acceptable Manufacturers:
 - 1. American Standard.
 - 2. Kohler.
 - 3. Eljer.
- B. Provide all appurtenances for a complete installation including wall carriers.
- C. Fixtures noted on the architectural plans as handicapped shall meet the requirements of ADA.

2.2 WALL HUNG URINALS

- A. Acceptable Manufacturers:
 - 1. American Standard.
 - 2. Kohler.
 - 3. Eljer.

- B. Provide all appurtenances for a complete installation including wall carriers.
- C. Fixtures noted on the architectural plans as handicapped shall meet the requirements of ADA.

2.3 LAVATORIES

- A. Acceptable Manufacturers
 - 1. American Standard.
 - 2. Kohler.
 - 3. Eljer.
- B. Provide lavatories as noted on the Architectural Drawings. Provide all appurtenances for a complete installation including semi-cast p-trap, chrome plated stops, wall carriers and chrome plated supply fittings.
- C. Accessories:
 - 1. Chrome plated semi-cast brass 17-gauge P-trap with clean-out plug and arm with escutcheon.
 - 2. Wheel handle stops (in public bathrooms provide keyed stops).
 - 3. Rigid supplies.
 - 4. Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.
- D. Fixtures noted on the architectural plans as handicapped shall meet the requirements of ADA.

2.4 MOP SINKS

- A. Acceptable Manufacturers
 - 1. Mustee.
 - 2. American Standard.
 - 3. Eljer.
- B. Provide all appurtenances for a complete installation including semi-cast p-trap, chrome plated stops, wall carriers and chrome plated supply fittings.
- C. Accessories:
 - 1. Chrome plated semi-cast brass 17-gauge P-trap with clean-out plug and arm with escutcheon.
 - 2. Wheel handle stops (in public bathrooms provide keyed stops).
 - 3. Rigid supplies.

2.5 WATER COOLERS

- A. Acceptable Manufacturers.
 - 1. Elkay.
 - 2. Haws.
- B. Provide all appurtenances for a complete installation.
- C. Water coolers shall meet the requirements of ADA.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Coordination and Meetings: Verification of existing conditions before starting work.
- B. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify that electric power is available and of the correct characteristics.
- D. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid supplies to fixtures with stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Division 7, color to match fixture.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Division 1 - Contract Closeout, Starting of Systems: Adjusting installed work.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Division 1 - Contract Closeout: Cleaning installed work.
- B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

- A. Division 1 - Contract Closeout: Protecting installed work.
- B. Do not permit use of fixtures.

3.8 SCHEDULES

- A. Refer to drawings for complete plumbing fixture schedule.
- B. All fixture heights, types, and locations shall be coordinated with the Architect.
- C. Fixture Rough-In - Refer to fixture manufacturer's rough-in guide.

END OF SECTION 224000

SECTION 224010 - PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor drains.
 - 2. Cleanouts.
 - 3. Hose bibbs.
 - 4. Backflow preventers.
 - 5. Water hammer arrestors.
 - 6. Thermostatic mixing valve.
- B. RELATED SECTIONS
 - 1. Section 221116 – Domestic Water Piping.
 - 2. Section 221316 – Sanitary, Waste and Vent Piping.
 - 3. Section 221413 – Storm Drainage Piping.
 - 4. Section 224000 - Plumbing Fixtures.
 - 5. Section 262800 - Wiring Connections: Electrical characteristics and wiring connections.
 - 6. Division 1 - Summary of Work: Product requirements for Owner furnished equipment.

1.2 REFERENCES

- A. ASME A112.21.1 - Floor Drains.
- B. ASME A112.26.1 - Water Hammer Arrestors.
- C. ASSE 1011 - Hose Connection Vacuum Breakers.
- D. ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- E. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- G. PDI WH-201 - Water Hammer Arrestors.

1.3 SUBMITTALS FOR REVIEW

- A. Division 1 - Submittals: Procedures for submittals.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1.4 SUBMITTALS FOR INFORMATION

- A. Division 1 - Submittals: Procedures for submittals.
- B. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 1 - Contract Closeout, Operation and Maintenance Data, Warranties and Bonds: Procedures for submittals.
- B. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, valves.
- C. Operation Data: Indicate frequency of treatment required for interceptors.
- D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.
- B. Accept specialties on site in original factory packaging. Inspect for damage.

1.8 MAINTENANCE PRODUCTS

- A. Division 1 - Contract Closeout, Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

- A. Floor Drains:
 - 1. Manufacturers:
 - a. Josam.
 - b. Zurn.
 - c. Wade.
 - d. Smith.

2.2 CLEANOUTS

- A. Cleanouts:
 - 1. Manufacturers:
 - a. Josam.
 - b. Zurn.
 - c. Wade.
 - d. Smith.

2.3 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Manufacturers:
 - a. Josam.
 - b. Zurn.
 - c. Wade.
 - d. Smith.
 - 2. Bronze or brass non-freeze type with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in conformance with ANSI/ASSE 1011.

2.4 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers:
 - 1. Manufacturers:
 - a. Watts.
 - b. Zurn.
 - c. Josam.
 - d. Substitutions: Not permitted.
 - 2. AWWA C511; Epoxy coated cast iron body with bronze internal parts and stainless steel trim; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
- B. Double Check Valve Assemblies:
 - 1. Manufacturers:
 - a. Watts.
 - b. Zurn.
 - c. Josam.
 - d. Substitutions: Not permitted.
 - 2. AWWA C510-89 epoxy coated cast iron body with bronze resistant internal parts and stainless steel trim; two independently operating check valves with intermediate atmospheric vent.

2.5 THERMOSTATIC MIXING VALVES

- A. Manufacturer: Symmons.

- B. Other acceptable manufacturers offering equivalent products.
 - 1. Lawler.
- C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- D. Accessories:
 - 1. Check valve on inlets.
 - 2. Volume control shut-off valve on outlet.
 - 3. Stem thermometer on outlet.
 - 4. Strainer stop checks on inlets.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in reinforced concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.

END OF SECTION 224010

**DOUGHBOY AFFORDABLE LIVING
3350 PENN AVENUE AND 3400 PENN AVENUE
AVENUE PITTSBURGH, PENNSYLVANIA**

SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains Antifreeze, pedestal.
 - 1. Standard: Comply with NSF 61 Annex G.
 - 2. Designed to operate without draining into ground.
 - 3. Pedestal: Rectangular, painted cast iron or steel.
 - 4. Receptor: Rectangular, chrome-plated brass or stainless steel with bubbler.
 - 5. Maximum water flow: .5 gpm.
 - 6. Control: Foot pedal with control valve assembly.
 - 7. Supply Fittings: Underground shutoff and flow-control valve assembly.
 - 8. Drain: Grid type with 1-1/2" minimum waste.
 - 9. Bury Depth, Grade to Valve Components: 36"

Northview Heights Midrise Development

Fukui Architects Project #2040

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February 9, 2022 Construction Set

- 10. Supply Piping: 1/2"
- 11. Waste Piping: 1-1/2" minimum trap and waste.

- B. Drinking Fountains: **Stainless steel**, wallmounted.

1. Bronze Drinking Fountains:
2. Stainless-Steel Drinking Fountains:
3. Vitreous-China Drinking Fountains:
4. Standards:
 - a. Comply with **ASME A112.19.2/CSA B45.1**.
 - b. Comply with NSF 61 Annex G.
5. Maximum water flow: **0.5 gpm**.
6. Control: **Push button**
7. Drain: Grid type with 1-1/4" tailpiece.
8. Supply: 3/8" with shutoff valve.
9. Waste Fitting: ASME A112.18.2/CSA B125.2, 1-1/4 chrome-plated brass P-trap and waste.
10. Support: **Type I water cooler carrier**
11. Drinking Fountain Mounting Height: **Standard** and **Handicapped/elderly according to ICC A117.1**.

2.2 SUPPORTS

- A. Type I Water Cooler Carrier:
 1. Standard: ASME A112.6.1M.
- B. Type II Water Cooler Carrier:
 1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains on floor.
- C. Install recessed drinking fountains secured to wood blocking in wall construction.
- D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to

domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they

can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.

2. Dielectric fittings.
3. Mechanical sleeve seals.

- 4. Escutcheons.
- B. Welding certificates.
- 1.5 QUALITY ASSURANCE
 - A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
 - B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 - C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
 - B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- 1.7 COORDINATION
 - A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
 - B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
 - C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- PART 2 - PRODUCTS
- 2.1 MANUFACTURERS
 - A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- 2.2 PIPE, TUBE, AND FITTINGS
 - A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
 - B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- 2.3 JOINING MATERIALS
 - A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
 - B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
 - C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
 - D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
 - E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 - F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
 - G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 - H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.
- 2.4 TRANSITION FITTINGS
- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.
 - B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
 - C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- 2.5 DIELECTRIC FITTINGS
- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
 - B. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.

- e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
- 2.6 MECHANICAL SLEEVE SEALS
 - A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends and a welded steel water stop, unless otherwise indicated.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with setscrew.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
 - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
 - F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
 - I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
 - K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
 - L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
 - M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- 3.3 PIPING CONNECTIONS
- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
 - B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 23 0500

SECTION 230529 - HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Inserts.
 - 2. Flashing.
 - 3. Firestopping relating to mechanical work.
 - 4. Firestopping accessories.
 - 5. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 230548 - Mechanical Sound, Vibration, and Seismic Control: Product and execution requirements for vibration isolators.
 - 2. Section 232113 - Heating and Cooling Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.9 - Building Services Piping.
- B. American Society for Testing and Materials:
 - 1. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Factory Mutual System:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.
- G. Warnock Hersey:
 - 1. WH - Certification Listings.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction.
- B. Surface Burning: ASTM E84, UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with all local codes and standards.
- B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 WARRANTY

- A. Division 1 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.1 INSERTS

- A. Manufacturers:
 - 1. Grinnell.
 - 2. B-line.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.2 FLASHING

- A. Refer to roofing specifications.

2.3 FIRESTOPPING

- A. Manufacturers:

1. Dow Corning Corp.
2. 3M fire Protection Products.
3. Substitutions: Division 1 - Product Requirements.

- B. Furnish materials in accordance with all local codes and standards.

- C. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

2.4 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

- B. Dam Material: Permanent:
1. Mineral fiberboard.
 2. Mineral fiber matting.

- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

- D. General:
1. Furnish UL listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.

- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is

- 2. exposed.
For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve, link-seal or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Engineer before using powder-actuated anchors.
- D. Do not drill or cut structural members.
- E. Obtain permission from Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4" thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 230548.

3.5 INSTALLATION – FLASHING

- A. All roof work shall be performed in strict accordance with the roofing contractor's requirements. On new or warranted work MC shall pay the roofing contractor to perform all of his roof work.
- B. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- C. Flash vent and soil pipes projecting 12 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- D. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- E. Seal floor drains watertight to adjacent materials.
- F. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- G. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- H. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.

- c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where conduit, and penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
- 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

3.7 FIELD QUALITY CONTROL

- A. Division 1 - Quality Requirements, 014000 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Division 1 - Execution Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Division 1 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 230529

SECTION 230548 - MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vibration isolation.
- B. PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
 - 1. Division 3 - Concrete: Placement of isolators in floating floor slabs.
- C. PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION
 - 1. Division 3 - Concrete: Supply of concrete for placement by this Section.
- D. RELATED SECTIONS
 - 1. Division 3 - Cast-in-Place Concrete.
 - 2. Section 230529 – Hangers and Supports.
 - 3. Section 230543 - Piping Expansion Compensation.
 - 4. Section 262800 - Wiring Connections

1.2 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping and ductwork.
- B. Provide minimum static deflection of isolators for equipment as indicated.
 - 1. Under 400 rpm: 4 inch
 - 2. 400 - 600 rpm: 3.0 inch
 - 3. 600 - 800 rpm: 2 inch
 - 4. 800 - 900 rpm: 1 inch
 - 5. 1100 - 1500 rpm: 0.5 inch
 - 6. Over 1500 rpm: 0.5 inch
- C. Use concrete inertia bases for fans having static pressure in excess of 3.5 inch WC or for base mounted motors in excess of 10 HP, and on base mounted pumps 7.5 HP or over.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
- C. Product Data: Provide schedule of vibration isolator type with location and load on each.
- D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
- E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet

or exceed specified requirements.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Peabody Noise Control.
- B. Substitutions: Division 1 - Product Requirements.

2.2 VIBRATION ISOLATORS

- A. Open Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Spring Mounts: Provide with levelling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- B. Restrained Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Spring Mounts: Provide with levelling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 - 5. Restraint: Provide heavy mounting frame and limit stops.
- C. Closed Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
- D. Restrained Closed Spring Isolators:
 - 1. Spring Isolators:

- a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
- E. Spring Hanger:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 - 4. Misalignment: Capable of 20 degree hanger rod misalignment.
- F. Neoprene Pad Isolators:
 - 1. Rubber or neoprene waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs shall not exceed 0.7 times width.
 - 2. Configuration: Single layer.
- G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.
- H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install isolation for motor driven equipment.
- C. Install spring hangers without binding.
- D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- F. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and

on hanger supported, horizontally mounted axial fans.

- G. Support piping connections to isolated equipment resiliently as follows:
 - 1. Up to 4 Inch Diameter: First three points of support.
 - 2. 5 to 8 Inch Diameter: First four points of support.
 - 3. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.
 - 4. Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Examine systems under provisions of Division 1.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION 230548

SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. National Fire Protection Association:
 - 1. NFPA 99 - Standard for Health Care Facilities.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Samples: Submit tags, labels, pipe markers, and size used on project.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.
- B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

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- C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 EXTRA MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Furnish materials in accordance with local codes and standards.
- C. Product Description: Laminated three-layer plastic with engraved letters on light contrasting background color.

2.2 TAGS

- A. Metal Tags:
 - 1. Manufacturers:
 - a. Seton.
 - b. Brady.
 - c. Substitutions: Refer to Division 1 - Product Requirements.
 - 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- B. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.3 STENCILS

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Substitutions: Division 1 - Product Requirements.

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- B. Furnish materials in accordance with all local codes and standards.
- C. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 - 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 - 4. Ductwork and Equipment: 1-3/4 inches high letters.
- D. Stencil Paint: As specified in Division 9, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Seton.
 - b. Brady.
 - c. Substitutions: Refer to Division 1 - Product Requirements.
 - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Seton.
 - b. Brady.
 - c. Substitutions: Refer to Division 1 - Product Requirements.
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install tags using corrosion resistant chain. Number tags consecutively by location.
- D. Identify make-up air units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- E. Identify control panels and major control components outside panels with plastic nameplates.

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- F. Identify valves in main and branch piping with tags.
- G. Identify air terminal units and radiator valves with numbered tags.
- H. Tag automatic controls, instruments, and relays. Key to control schematic.
- I. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- J. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 230553

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Mechanical Identification

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing adjusting, and balancing of hydronic and air-systems.
- B. Related Sections:
 - 1. Section 230900 - Direct Digital Controls: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.2 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- B. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Test Reports: Indicate data on forms containing information indicated in Schedules.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and Copy of NEBB Certificate of Conformance Certification.
- F. Submit draft copies of report for review prior to final acceptance of Project.
- G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.

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- B. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

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1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- B. Maintain one copy of each document on site.
- C. Prior to commencing Work, calibrate each instrument to be used. [Upon completing Work, recalibrate each instrument to assure reliability.]

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years experience and Certified by NEBB.
- B. Perform Work under supervision of NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 SEQUENCING

- A. Division 1 - Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.8 SCHEDULING

- A. Division 1 - Administrative Requirements: Coordination and project conditions.

PART 2 PRODUCTS
Not used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.

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12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.

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15. Service and balancing valves are open.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Division 1 - Execution Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities [at site altitude].
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- D. Measure static air pressure conditions on air supply units, including filter and coil

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pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

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- E. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- F. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- G. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- H. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain neutral static building pressure near building entries.
- I. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

3.6 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. VRF System
 - 2. Fan-coil Units
 - 3. Exhaust Fans
 - 4. Energy Recovery Units
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
 - 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
 - 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range

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- 4.
 - f. Calibration date
 - Electric Motors:
 - a. Manufacturer
 - b. Model/Frame

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- c. HP/BHP and kW
- d. Phase, voltage, amperage; nameplate, actual, no load
- e. RPM
- f. Service factor
- g. Starter size, rating, heater elements
- h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP and kW
 - g. Actual flow rate, pressure drop, BHP and kW
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
- 7. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Water flow, design and actual
 - k. Water pressure drop, design and actual
 - l. Entering water temperature, design and actual
 - m. Leaving water temperature, design and actual
 - n. Saturated suction temperature, design and actual
 - o. Air pressure drop, design and actual
- 8. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure

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- l. Sheave Make/Size/Bore
- m. Number of Belts/Make/Size
- n. Fan RPM

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9. Combustion Test:
 - a. Manufacturer
 - b. Model number
 - c. Serial number
 - d. Firing rate
 - e. Overfire draft
 - f. Gas meter timing dial size
 - g. Gas meter time per revolution
 - h. Gas pressure at meter outlet
 - i. Gas flow rate
 - j. Heat input
 - k. Burner manifold gas pressure
 - l. Percent carbon monoxide (CO)
 - m. Percent carbon dioxide (CO₂)
 - n. Percent oxygen (O₂)
 - o. Percent excess air
 - p. Flue gas temperature at outlet
 - q. Ambient temperature
 - r. Net stack temperature
 - s. Percent stack loss
 - t. Percent combustion efficiency
 - u. Heat output
10. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio
 - n. Exhaust Fan Data:
11. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure
 - h. Discharge pressure
 - i. Sheave Make/Size/Bore
 - j. Number of Belts/Make/Size
 - k. Fan RPM
12. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity

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- e. Design air flow
- f. Test velocity
- g. Test air flow

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- h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
13. Duct Leak Test:

Duct leakage testing to be completed by PHIUS + Multi-family verifier.

- a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
 - g. Test static pressure
 - h. Test orifice differential pressure
 - i. Leakage
14. Terminal Unit Data:
- a. Manufacturer
 - b. Type, constant, variable, single, dual duct
 - c. Identification/number
 - d. Location
 - e. Model number
 - f. Size
 - g. Minimum static pressure
 - h. Minimum design air flow
 - i. Maximum design air flow
 - j. Maximum actual air flow
 - k. Inlet static pressure
15. Air Distribution Test Sheet:
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow

END OF SECTION 230593

SECTION 230710 - DUCTWORK INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ductwork insulation.
 - 2. Duct liner.
- B. RELATED SECTIONS
 - 1. Section 233113 - Ductwork.

1.2 REFERENCES

- A. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- B. ASTM E84 - Surface Burning Characteristics of Building Materials.
- C. ASTM E96 - Water Vapor Transmission of Materials.
- D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- E. UL 723 - Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. According to the provisions of Division 1.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723.

1.5 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
- B. Store insulation in original wrapping and protect from weather and construction traffic.

- C. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

PART 2 PRODUCTS

2.1 GLASS FIBER DUCT LINER, RIGID

- A. Manufacturers:
 - 1. Owens Corning Aeroflex, type 200.
 - 2. Equal by Cetainteed.
 - 3. Equal by Knauf.
- B. Insulation: ASTM C612; semi-rigid, noncombustible.
 - 1. 'K' value : ASTM C518, 0.26 at 75 degrees F.
 - 2. Maximum service temperature: 250 degrees F.
 - 3. Maximum Velocity on Coated Air Side: 5,000 ft/min.
 - 4. Density : 2.0 pounds/cubic foot.

2.2 GLASS FIBER DUCT WRAP

- A. Manufacturers:
 - 1. Owens Corning All Service Duct Wrap type 100.
 - 2. Equal by Certainteed.
 - 3. Equal by Manville.
- B. Insulation: ASTM C553; faced, fiber glass blanket.
 - 1. 'K' value : ASTM C518, 0.25 at 75 degrees F.
 - 2. Maximum service temperature: 250 degrees F.
 - 3. Water vapor permeance: 0.02 perms max.
 - 4. Facing: ASTM C1136, factory laminated, reinforced foil/kraft.
 - 5. Density : 1.0 pounds/cubic foot.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive complying with ASTM 916 for 100 percent coverage.
 - 2. Secure insulation with impact driven or weld secured mechanical liner fasteners. Refer to SMACNA Standards for spacing, but do not space with fewer fasteners than called for by manufacturer's instructions.

3. Liner shall be cut to assure overlapped and compressed longitudinal corner joints. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. Seal and smooth joints. Transverse duct joints and all exposed edges shall be coated.
 4. Seal liner surface penetrations with adhesive.
 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
 6. After installation, blow out duct system to remove foreign material remaining in duct. Coordinate with Owner and G.C. to protect interior building finishes and furnishings prior to blowing out duct.
 7. Provide insulation with vapor barrier jackets.
 8. Finish with tape and vapor barrier jackets.
 9. Continue insulation through walls, sleeves, hangers, and other duct penetrations unless prohibited by code.
 10. Insulate entire system including fittings, joints, flanges, flexible connections, and expansion joints.
- C. Flexible Duct installation:
1. Install without crimping flexible duct. Install sheet metal duct where necessary to avoid crimping.
 2. Flexible duct shall not be installed with turns in duct having centerline bending radius greater than 1 duct diameter.
 3. Flexible duct shall be installed only at connections from sheet metal duct to diffusers.
 4. Flexible duct shall not be installed in lengths greater than 6 feet.
 5. Connect flexible duct to sheet metal duct by overlapping flexible duct over sheet metal, and use drawband plus fasteners for attaching.
- D. Duct Wrap installation:
1. Before applying duct wrap, ducts shall be clean and dry. Completely follow all of manufacturer's installation recommendations.
 2. Install duct wrap with facing outside. Insulation shall be tightly butted, with tape flaps overlapping insulation and facing, and installed so that insulation is not excessively compressed at duct corners. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners as required to prevent sagging.
 3. Seal jacket joints with pressure sensitive tape, either foil or FRK backing stock, to provide a vapor tight system.
 4. Where ducts are 24" in width or greater, duct wrap shall be additionally secured to duct with mechanical fasteners, spaced on 18" centers.
 5. Stop and point insulation around access doors and damper operators to allow operation with disturbing wrapping.
 6. For exterior applications, provide insulation with a vapor barrier jacket. Cover with outdoor jacket finish as specified with caulked aluminum jacket with seams located on bottom side of horizontal duct section. Waterproofing shall be ASTM E162 fire retardant type

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance equal to or better than materials indicated, at normal conditions.

3.4 INSULATION SCHEDULE

- A. See schedule on drawings.

END OF SECTION 230710

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: [1/4 inch equals 1 foot (1:50)] <Insert value>.
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.

3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).

5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Flanged Unions:
 1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 (DN 25 to DN 40) and ductile iron for NPS 2 to NPS 3 (DN 50 to DN 80). Apply rust-resistant finish at factory.
 2. Gasket: Fiber asbestos free.
 3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
 4. End Connections: Brass tailpiece adapters for solder-end connections to coppertubing.
 5. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 6. Pressure Rating: Factory test at minimum 400 psig (2760 kPa).
 7. Maximum Operating Temperature: 330 deg F (165 deg C).
- F. Flexible Connectors:
 1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
 2. End Connections:
 - a. NPS 2 (DN 50) and Smaller: With threaded-end connections.
 - b. NPS 2-1/2 (DN 65) and Larger: With flanged-end connections.
 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 3. Operator: Rising stem and hand wheel.

4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).

7. Maximum Operating Temperature: 275 deg F (135 deg C).
- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
 2. Packing: Molded stem, back seating, and replaceable under pressure.
 3. Operator: Rising stem.
 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 5. Seal Cap: Forged-brass or valox hex cap.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Working Pressure Rating: 500 psig (3450 kPa).
 8. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig (3450 kPa).
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and [24] [115] [208]-V ac coil.
 6. Working Pressure Rating: 400 psig (2760 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
 8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.

5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: [40 deg F (4.4 deg C)] <Insert temperature>.
 6. Superheat: [Adjustable] [Nonadjustable].
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: [700 psig (4820 kPa)] [450 psig (3100 kPa)] <Insert value>.
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Equalizer: [Internal] [External].
 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and [24] [115] [208]-V ac coil.
 8. End Connections: Socket.
 9. Set Pressure: <Insert psig (kPa)>.
 10. Throttling Range: Maximum 5 psig (34 kPa).
 11. Working Pressure Rating: 500 psig (3450 kPa).
 12. Maximum Operating Temperature: 240 deg F (116 deg C).
- I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig (3450 kPa).
 5. Maximum Operating Temperature: 275 deg F (135 deg C).
- J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3450 kPa).
 6. Maximum Operating Temperature: 275 deg F (135 deg C).
- K. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.

5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

- L. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated [alumina] [charcoal].
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: [2 psig (14 kPa)] <Insert value>.
 8. Rated Flow: <Insert tons (kW).>
 9. Working Pressure Rating: 500 psig (3450 kPa).
 10. Maximum Operating Temperature: 240 deg F (116 deg C).
- M. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated [alumina] [charcoal].
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: [2 psig (14 kPa)] <Insert value>.
 8. Rated Flow: <Insert tons (kW).>
 9. Working Pressure Rating: 500 psig (3450 kPa).
 10. Maximum Operating Temperature: 240 deg F (116 deg C).
- N. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or flare.
 3. Working Pressure Rating: 500 psig (3450 kPa).
 4. Maximum Operating Temperature: 275 deg F (135 deg C).
- O. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 2. Comply with UL 207; listed and labeled by an NRTL.
 3. Body: Welded steel with corrosion-resistant coating.
 4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
 5. End Connections: Socket or threaded.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 275 deg F (135 deg C).
- P. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or threaded.
 3. Working Pressure Rating: 500 psig (3450 kPa).
 4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.4 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed soldered joints.
- B. Suction Lines NPS 3-1/2 (DN 90) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR L (B), drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Suction Lines: NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR K (A), drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed soldered joints.
- E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- F. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications NPS 2 to NPS 4 (DN 50 to DN 100), Schedule 40, black-steel and wrought-steel fittings with welded joints.
- G. Safety-Relief-Valve Discharge Piping: Copper, Type ACR L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor

suction connection.

- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated

otherwise.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 - 1. Shot blast the interior of piping.
 - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

- S. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
2. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
3. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (9.5 mm).
4. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

- a. Fill system with nitrogen to the required test pressure.

- b. System shall maintain test pressure at the manifold gage throughout duration of test.
- c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - DUCTWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal ductwork.
 - 2. Nonmetal ductwork.

1.2 RELATED SECTIONS

- A. Section 230529 – Hangers and Supports.
- B. Section 230700 - Duct Insulation: External insulation and duct liner.
- C. Section 233300 - Ductwork Accessories.
- D. Section 233713 - Air inlets and Outlets.
- E. Section 230593 - Testing, Adjusting and Balancing.

1.3 REFERENCES

- A. ASTM A 36 - Structural Steel.
- B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- E. SMACNA - HVAC Air Duct Leakage Test Manual.
- F. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- G. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission.

1.5 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for 4 inch pressure class and higher, and kitchen hood exhaust systems.
- C. Product Data: Provide data for duct materials, duct liner and duct connectors.

- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum five years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of in conformance with ASTM A90.
- B. Flexible Ducts:
 - 1. Manufacturers: See Section 233300.
 - 2. Two ply vinyl film supported by helically wound spring steel wire.
 - 3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - 4. Maximum Velocity: 4000 fpm.
 - 5. Temperature Range: -20 to 180 degrees F.
- C. Fasteners: Rivets, bolts, or sheet metal screws.
- D. Sealant:
 - 1. Manufacturers:
 - a. United McGill.
 - 2. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

- E. Hanger Rod: ASTM A36; steel, galvanized (in wet locations); threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 30 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Round Spiral Ducts:
 - 1. Manufacturers:
 - a. United McGill.
 - b. SEMCO.
 - 2. Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gages heavier metal than duct.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in accordance with SMACNA HVAC Duct Construction Standards.
- B. Install and seal ducts and all galvanized duct joints in accordance with SMACNA HVAC Duct Construction Standards, seal Class B with water based sealant by United McGill.
- C. All duct dimensions shown on drawings are clear inside dimensions. Increased duct sizes to allow for insulation as specified.
- D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete

with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use double nuts and lock washers on threaded rod supports.
- G. Slope underground ducts to low points at 1:500.
- H. Connect flexible ducts to metal ducts per flexible duct manufacturers recommendations.
- I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- J. Access doors shall be installed in ducts at all points shown on drawings or specified herein, and wherever necessary to provide access to adjustable accessories installed in ductwork.
- K. Duct shall be relocated as necessary to miss building obstructions.
- L. It shall be the responsibility of the MC to carefully review architectural plans and site conditions to maintain proper clearances.

3.2 CLEANING

- A. Clean work under provisions of Division 1.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.3 SCHEDULES

- A. See schedule on drawings.

END OF SECTION 233113

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Air turning devices.
 - 2. Backdraft dampers.
 - 3. Fire dampers
 - 4. Duct access doors.
 - 5. Duct test holes.
 - 6. Flexible duct connections.
 - 7. Volume control dampers.
 - 8. Louvers.
 - 9. Duct Detectors.
 - 10. Ceiling Radiation Dampers.
- B. RELATED SECTIONS
 - 1. Section 233113 - Ductwork.
 - 2. Section 262800 – Wiring Connections: Electrical characteristics and wiring connections.

1.2 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. NFPA 92A - Smoke Control Systems.
- C. NFPA 70 - National Electrical Code.
- D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide for shop fabricated assemblies.
- C. Manufacturer's Installation Instructions: Provide for all dampers.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years experience.

1.6 REGULATORY REQUIREMENTS

- A. Fire dampers: Listed and classified by Underwriters' Laboratories Inc., as suitable for the

purpose specified and indicated. All fire dampers shall be Dynamic type.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES

- A. Single thickness, constructed to SMACNA standards for a pressure loss coefficient of 0.24.

2.2 BACKDRAFT DAMPERS (Barometric Type)

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Ruskin.
- B. Backdraft dampers size 18 x 18 inches or smaller and furnished with Air Moving Equipment: Provide Air Moving Equipment manufacturer's standard low leakage construction.
- C. Backdraft dampers installed in duct: Shall be counterbalancing type with adjustable counterbalance for adjusting pressure differential required to open damper, with flangeless frame for duct mounting, 0.063 thick 6063T5 extruded aluminum frame, 0.050 thick 6063T5 extruded aluminum blades with vinyl seals on closing edge, 3/16" diameter zinc plated axles mounted in acetal bushings, 20 gauge galvanized tie bar counterbalances, welded corners.

2.3 FIRE DAMPERS.

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Cesco.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations with closure under air flow conditions (dynamic). Configure with blades out of air stream.
- D. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- E. Fusible Links: UL 33, separate at 165 degrees F for cooling only ducts and 212 degrees F for heating/cooling ducts.

2.4 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabrication: Rigid and close-fitting, of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
 - 1. Less Than 12 Inches Square: Secure with sash locks.
 - 2. Up to 18 Inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 x 48 Inches: Three hinges and two compression latches.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.5 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant, neoprene coated, woven glass fiber fabric.
 - 2. Net Fabric Width: 3 inches, minimum.

2.7 MANUAL VOLUME CONTROL DAMPERS.

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Arrow.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Single Blade Dampers: 20 gauge galvanized steel with spring end bearing and lockable quadrant.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch Assemble center and edge crimped blades in 16 gauge galvanized channel frame with suitable hardware.
- E. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings;
- F. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches, provide regulator at both ends.

2.8 LOUVERS

A. Manufacturers

1. Ruskin.
 2. Greenheck.
- B. Louvers shall be stationary type. Stationary blades shall be contained within a single 4" frame. Louver components(heads, jambs, sills, blades and mullions) shall be factory assembled by the louver manufacturer. Louver design shall incorporate structural supports required to withstand a wind load of 20 psf. Water penetration shall be less than 0.01 oz./sq.ft. at less than 840 fpm.
1. Frames : 0.081" extruded aluminum wall thickness.
 2. Blades : 0.081" extruded aluminum wall thickness at 37-1/2 degrees on approximately 3" centers.
 3. Screens : 3/4" x 0.051" expanded flattened aluminum in removable frame.
- C. Louvers shall be finished to match the building material in which they are installed; coordinate finish with the Architect.

2.9 CONTROL DAMPERS

- A. Manufacturers
1. Ruskin.
 2. Greenheck.
 3. Arrow.
- B. Construction: 16 gauge galvanized steel hat channel frame with 14 gauge equivalent thickness double skin airfoil construction blades, 6" width with blade extensions optional to meet size requirements. Seals shall be extruded vinyl blade edge inflatable type mechanically locked into blade for leakage of 6.0 cfm or less at 2" w.c. and 36" damper width. bearings shall be stainless steel sleeve type, and axles shall be 1/2" plated steel.

2.10 DUCT DETECTORS

- A. Duct detectors shall be furnished by the electrical contractor and installed by the mechanical contractor.

2.11 CEILING RADIATION DAMPERS

- A. Manufacturers
1. Greenheck
 2. Broan
- B. General Requirements:
1. Labeled according to UL 555C by an NRTL.
 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation.
- E. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.
- F. Fire Rating: 2 hour(s).

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 233113 for duct construction and pressure class. Install silencers to have a pressure drop multiplier factor of 1.0 according to manufacturer's literature, and to meet performance scheduled on drawings. Refer to Section 233113 for duct construction and pressure class.
- B. Provide motorized backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide 18 x 18 inch size for shoulder access where duct size allows. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and/or required for testing and balancing purposes.
- E. Provide fire dampers and associated access doors at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. Provide flexible connections on both sides of all air handling units, exhaust fans, and where shown on drawings.
- H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing, and where shown on drawings. Provide opposed blade dampers with 6 inch blades where balance dampers are required in ducts 18 X 12 or larger.
- I. Two position automatic control dampers shall be parallel blade. Modulating control dampers shall be opposed blade, except dampers in return and outside air ducts that constitute mixed air shall be parallel or opposed blade as required to effect mixing of the airstreams.

END OF SECTION 233300

Northview Heights Midrise Development
Fukui Architects Project #2040

PFHA Project No. 2021-156
February 9, 2022 Construction Set

SECTION 233416 - FANS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The Contract Documents, as defined within Division 1 - Construction Agreement, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

1.2 SUMMARY

- A. Section Includes:
 - 1. Centrifugal Ceiling Exhaust Cabinet Fan
- B. Related Sections:
 - 1. Section 262800 - Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 - Standards Handbook.
 - 2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- D. Underwriters Laboratories Inc.:
 - 1. UL 705 - Power Ventilators.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- B. Product Data: Submit data on fans and accessories including fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit fan manufacturers instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 1 - Project Closeout: Closeout procedures.
- B. Division 1 - Operation and Maintenance Data: Manuals for equipment.
- C. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Material and Equipment: Product storage and handling requirements.
- B. Protect motors, shafts, and bearings from weather and construction dust.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Division 1 - Warranties and Bonds: Product warranties and product bonds.
- B. Furnish one year manufacturer's warranty for fans.

1.10 EXTRA MATERIALS

- A. Division 1 - Project Closeout: Spare parts and maintenance products.
- B. Furnish two sets of belts for each fan.

PART 2 PRODUCTS

2.1 Centrifugal Ceiling Exhaust Cabinet Fan

- A. Manufacturers:
 - 1. Cook.
 - 2. Greenheck
 - 3. Broan
- B. Product Description:
 - 1. The fan housing shall be acoustically insulated galvanized steel.
 - 2. The fan wheel shall be centrifugal, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

Wheels shall be statically and dynamically balanced.

3. Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.
4. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.
5. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
6. Motor pulleys shall be adjustable for system balancing. A NEMA 1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.
7. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
8. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

C. Accessories:

1. Disconnect Switch: Factory-wired, non-fusible, in housing for thermal overload protected motor.
2. Back-draft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
3. Ceiling radiation dampers

D. Performance:

1. See Schedule on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Coordination - Multiple Prime Contracts: Coordination and project conditions.

3.2 INSTALLATION

- A. Install motorized backdraft dampers on inlet to exhaust fans.
- B. Install safety screen where inlet or outlet is exposed.
- C. Provide sheaves required for final air balance.

3.3 CLEANING

- A. Division 1 - Coordination - Multiple Prime Contracts: Requirements for cleaning.
- B. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Division 1 - Operation and Maintenance Data: Instruction of Owner personnel.
- B. Demonstrate fan operation.

3.5 PROTECTION OF FINISHED WORK

- A. Division 1 - Coordination - Multiple Prime Contracts: Requirements for protecting finished Work.
- B. Do not operate fans for until ductwork is clean, bearings lubricated, and fan has been test run under observation.

3.6 SCHEDULES

- A. See drawings for fan schedules.

END OF SECTION 233416

SECTION 233713 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diffusers.
 - 2. Registers/grilles.
 - 3. Louvers.

1.2 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ARI 650 - Air Outlets and Inlets.
- D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, pressure drop, application, and noise level.

1.4 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years experience.

PART 2 PRODUCTS

2.1 CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Price.
 - 2. Other acceptable manufacturers offering equivalent products.

- a. Kreuger.
 - b. Anemostat.
- B. Type: Square, die-stamped, diffuser to discharge air in 360 degree four way pattern. Provide with round-necked accessory.
- C. Frame: Surface mount or Inverted T-bar, as required.
- D. Fabrication: Aluminum with finish selected by architect.

2.2 WALL DIFFUSERS

- A. Manufacturers:
 - 1. Price.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Kreuger.
 - b. Anemostat.
- B. Type: Double-deflection, square louver with front blades parallel to long dimension. Coordinate duct connection sizes with manufacturer's recommendations.
- C. Frame: Surface mount or Inverted T-bar, as required.
- D. Fabrication: Aluminum with finish selected by architect.

2.3 LINEAR BAR DIFFUSERS

- A. Manufacturers:
 - 1. Price.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Kreuger.
 - b. Anemostat.
- B. Type: Extruded aluminum, deflection as specified on schedule. Suitable for use as supply or return. Coordinate duct connection sizes with manufacturer's recommendations.
- C. Frame: As required for mounting. Provide concealed frames on overhead ducts.
- D. Finish: Selected by architect.

2.4 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Price.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Kreuger.
 - b. Anemostat.
- B. All aluminum, 1/2 inch blade spacing, all blades individually adjustable. Finish selected by Architect.

2.5 LOUVERS

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Substitutions: Division 1 - Product Requirements.
- B. Product Description: Thin Line Stationary Louver.
- C. Type: 2 inch deep with blades on 35 degree slope and return bend, heavy channel frame.
- D. Fabrication: 6063T5 extruded aluminum with 0.060" nominal wall thickness with baked enamel finish, color per architect.
- E. Mounting: Furnish with exterior flat flange for installation.
- F. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Coordinate RGD frame type with wall and ceiling construction.

END OF SECTION 233713

238126 - VARIABLE REFRIGERANT FLOW SYSTEM

Part 1 – General

1.1 SYSTEM DESCRIPTION

The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system or approved equal.

1.2 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.
- E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Inspect all delivered equipment to ensure proper refrigerant pre-charge, condensate pumps and float switches (if any) are in proper working order, all equipment is clean and free from construction debris and dirt, all have clean; new filters, and controls (thermostats, timers, on/off function) are working in concert as intended.
- B. Unit shall be stored and handled according to the manufacturer's recommendation.

1.4 ENERGY EFFICIENCY REQUIREMENTS

- A. VRF system shall be Energy-Star Listed or meet the following energy efficiency requirements:

Equipment Type	Cooling Capacity	Minimum Energy Efficiency Criteria
VRF Air-Cooled Heat Pump	≥65,000 Btu/h <240,000 Btu/h	11.1 EER; 11.6 IEER; 3.3 COP at 47°F
VRF Air-Cooled Heat Pump	≥ 240,000 Btu/h	9.6 EER; 9.6 IEER; 3.2 COP at 47°F

1.5 CONTROLS

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
- C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
- D. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
- E. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
- F. System shall be capable of email generation for remote alarm annunciation.

Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi (or approved equal) controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi CMCN Essentials Training and/or CMCN Hands-On Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

Part 2 – Warranty

- 2.01 The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from date of installation.

If the systems are:

- 1) designed by a certified CITY MULTI Diamond Designer,
- 2) installed by a contractor that has successfully completed the Mitsubishi Electric three day service course (contractor must be a certified installer), AND
- 3) verified with a completed commissioning report submitted to and approved by the Mitsubishi Electric Service Department,

then the units shall be covered by an extended manufacturer's limited warranty for a period of five (5) years from date of installation.

In addition the compressor shall have a manufacturer's limited warranty for a period of seven (7)

years from date of installation.

If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

This warranty shall not include labor.

- 2.02 Manufacturer shall have a minimum of twenty-nine years of HVAC experience in the U.S. market.
- 2.03 All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
- 2.04 The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

Part 3 – Products

3.01 R2-SERIES OUTDOOR UNIT

A. General:

The R2-Series shall consist of the PURY-EP outdoor unit (or approved equal), indoor units, and M-NET DDC (Direct Digital Controls). The R2-Series outdoor unit shall be used specifically with CITY MULTI VRF components. The R2-Series PURY-EP outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped, wired and run tested at the factory.

1. The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.

Outdoor Unit Model Nomenclature		
208/230 Volt		Twinning Kit
Model Number	Units	
PURY-EP192TSNU-A	(2) PURY-EP96YNU-A	CMY-R200NCBK
PURY-EP192TSNU-A	(2) PURY-EP96YNU-A	CMY-R200NCBK
PURY-EP192TSNU-A	(2) PURY-EP96YNU-A	CMY-R200NCBK

PURY-EP240TSNU-A	(2) PURY-EP120TNU-A	CMY-R200NCBK
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2. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.
3. Outdoor unit shall have a sound rating no higher than 58 dB(A) individually or 61 dB(A) twinned. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
4. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
5. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
6. Outdoor unit shall be able to connect to up to 48 indoor units depending upon model.
7. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
8. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
9. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
10. The outdoor unit shall have rated performance of heating operation at -13°F ambient temperatures and cooling mode down to 23°F ambient temperatures, without additional low ambient controls. The unit shall maintain 100% heat output at 0°F without a supplemental

heat source or a second compressor to boost low ambient heating performance. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.

11. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
12. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.
13. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.

B. Heat Interchanger circuit.

1. The outdoor unit shall contain a heat interchanger circuit for sub-cooling liquid prior to entering the outdoor coil during the heating mode.
2. The interchanger shall be of a copper tube within a tube construction.
3. The interchanger circuit refrigerant flow shall be controlled by an electronic expansion valve.

C. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

D. Fan:

1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

E. Refrigerant

1. R410A refrigerant shall be required for PURY-EP-T/Y(S)KMU-A outdoor unit systems.
2. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

F. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

G. Basepan Heater:

1. Each outdoor unit module shall be equipped with a basepan heater. Basepan heater shall activate only when compressor is operating in heating mode at an outdoor ambient temperature of 39F or below. If an alternate manufacturer is selected, any additional material, cost, and labor to meet basepan heater condition and performance shall be incurred by the contractor.

H. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

I. Controls:

1. The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system

J. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz).

3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

3.02 BRANCH CIRCUIT (BC) CONTROLLERS FOR R2-SERIES SYSTEMS

A. General

The BC (Branch Circuit) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.

The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant

1. R410A refrigerant shall be required.

D. Refrigerant valves:

1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
2. Each branch shall have multiple two-position valves to control refrigerant flow.
3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

E. Future Use

1. Each VRF system shall include at least one (1) unused branches or branch devices for future use. Branches shall be fully installed & wired in central location with capped service shutoff valve & service port.

F. Integral Drain Pan:

1. An Integral drain pan and drain shall be provided

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
3. The BC Controller shall be controlled by integral microprocessors
4. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

3.03

PEFY-NMAU (CEILING-CONCEALED DUCTED) INDOOR UNIT

A. General:

The PEFY-NMAU unit (or approved equal) shall be a ceiling-concealed ducted indoor fan coil that mounts above the ceiling with a rear return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The PEFY-NMAU shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PEFY-NMAU shall support individual control using M-NET DDC controllers. PEFY (Low Profile) models shall have an extremely compact profile (7-7/8") which requires minimal ceiling space. PEFY-NMAU models shall feature external static pressure settings up to 0.20 in. WG. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.

B. Indoor Unit.

The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The cabinet shall be space saving, low profile, ceiling-concealed ducted.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

D. Fan:

1. The indoor unit fan shall be an assembly with one Sirocco fan direct driven by a single motor.

2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, High, Mid, and Low.
4. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter:

1. Return air shall be filtered by means of a standard factory installed return air filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 21 inches above the condensate pan.
7. Both refrigerant lines to the PEFY indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system. Please refer to Part 5 of this guide specification for details on controllers and other control options.
2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

3.04 PVFY (MULTI-POSITION AIR HANDLER) INDOOR UNIT

A. General:

The PVFY (or approved equal) shall be a vertical flow multi-position air handler mounted on a return air stand with supply and return duct connections and shall have a modulating linear expansion device. The PVFY shall be used with the R2-Series outdoor unit and BC Controller, Y- Series outdoor unit, or S-Series outdoor unit. The PVFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit

The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet

1. The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted, pre-insulated, 22 gauge galvanized steel.

D. Fan:

1. The indoor unit fan shall be an assembly with a single, statically and dynamically balanced direct drive fan with a high efficiency DC motor with permanently lubricated bearings.
2. The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In. WG selectable.

E. Filter:

1. The unit shall have a 1" filter rack with a reusable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the PVFY indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system. Please refer to Part 5 of this guide specification for details on controllers and other control options.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
3. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
4. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

Part 4 – Controls

4.01 Overview

A. General:

The CITY MULTI Controls Network (CMCN) shall be capable of supporting remote controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

4.02 Electrical Characteristics

A. General:

The CMCN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.

B. Wiring:

1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
2. Control wiring for the Smart ME remote controller shall be from the remote controller to the first associated indoor unit (TB-5) M-NET connection. The Smart ME remote controller shall be assigned an M-NET address.
3. Control wiring for the Simple MA and Wireless MA remote controllers shall be from the

remote controller (receiver) to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration.

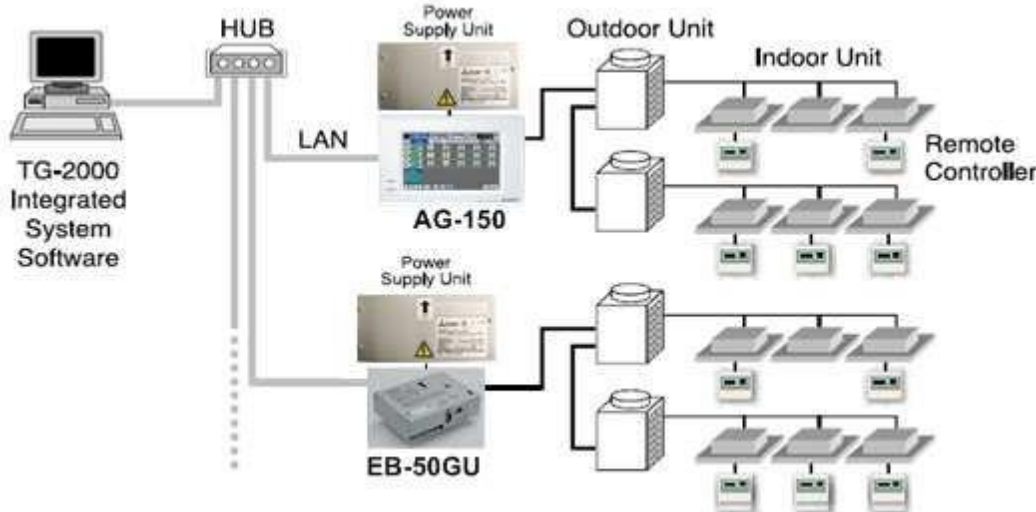
4. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.
5. The AE-200, AE-50, and EB-50GU centralized controller shall be capable of being networked with other AE-200, AE-50, and EB-50GU centralized controllers for centralized control.

C. Wiring type:

1. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.
2. Network wiring shall be CAT-5 with RJ-45 connection.

4.03 CITY MULTI Controls Network

The CITY MULTI Controls Network (CMCN) (or approved equal) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



CMCN System Configuration

4.04 CMCN: Remote Controllers

A. Smart ME Remote Controller (PAR-U01MEDU)

The Smart ME Remote Controller (PAR-U01MEDU) shall be capable of controlling up to 16 indoor units (defined as 1 group). The Smart ME Remote Controller shall be approximately 5.5" x 5" in size and white in color with an auto-timeout touch screen LCD display. The Smart ME

Remote Controller shall support a selection from multiple languages (English, Spanish or French) for display information. The Smart ME supports temperature display selection of Fahrenheit or Celsius. The Smart ME Remote Controller shall control the following grouped operations: On/Off, Operation Mode (cool, heat, auto*, dry, fan and setback* (*R2/WR2-Series Simultaneous Heating and Cooling only)), temperature set point, fan speed setting, and airflow direction setting. The Smart ME Remote Controller shall support timer settings of on/off/temperature up to 8 times in a day in 5-minute increments. The Smart ME Remote Controller shall support an Auto Off timer. The Smart ME Remote Controller shall be able to limit the set temperature range from the Smart ME Remote Controller, or via a PC through a licensed EB-50GU. Also, the temperature range can be set from a touch screen panel on the TC-24. The room temperature shall be sensed at either the Smart ME Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Smart ME Remote Controller shall display a four-digit error code in the event of system abnormality or error.

The ME Remote Controller shall only be used in same group with other ME Remote Controllers with a maximum of two ME Remote Controllers per group.

The ME Remote Controller shall require manual addressing using rotary dial switch to the M-NET communication bus. The ME Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB5 connection terminal on the indoor unit.

PAR-U01MEDU (Smart ME Remote Controller)			
Item	Description	Operation	Display
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Backlight	Turns on when screen is touched. Timeout duration is adjustable.	Each Group	Each Group
PAR-U01MEDU (Smart ME Remote Controller)			
Item	Description	Operation	Display
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Room Temp and Humidity Display	Displays the room temperature and humidity on the Home screen. Temperature and Humidity sensed can be calibrated using the sensor offset in 1 °F or 1% RH increments.	N/A	Each Group
Occupancy Sensor	Detects occupancy using an infrared motion sensor. Occupancy status is indicated on the remote controller and through the web interface depending on connected equipment. Sensitivity is adjustable.	N/A	Each Group
Brightness Sensor	Detects brightness in the space and indicates brightness on the remote controller and through the web browser interface depending on connected equipment. Sensitivity is adjustable.	N/A	Each Group

Status Monitor	Displays the status of general equipment control points connected to the Advanced HVAC Controller (DC-A2IO)	N/A	Each Group
Humidity Setting	Sets the relative humidity set point in 1% increments for any humidifier connected to the Advanced HVAC Controller (DC-A2IO)	Each Group	Each Group
LED Indicator	Can be set to indicate the operation status by lighting and flashing with different colors and brightness or by turning off to signal operation mode, stopped unit, error, occupancy, or home screen button pushes. Color can be set to indicate the current mode selected or room temp range being sensed. *Available colors include blue, light blue, yellow, white, green, red, and lime.	Each Group	Each Group
Schedule	Set up to 8 operations per day, 7 days per week. Operations include time on/off, mode and room temperature set point.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction, Reset filter). *1: Operation icon lights up on the remote controller for prohibited functions.	N/A	Each Group *1
Energy-Save control during vacancy	When vacancy is detected by the occupancy sensor 5 control options are available for selection: Stop/Setback Mode/Set Temperature Offset/Low Fan Speed/Thermo-off Brightness sensor can be used in conjunction with the occupancy sensor to increase accuracy.	Each Group	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode.	Each Group	Each Group
PAR-U01MEDU (Smart ME Remote Controller)			
Item	Description	Operation	Display
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit. LOSSNAY items that can be set are "Hi", "Low", and "Stop". Ventilation mode switching is not available.	Each Group	Each Group
Set Temperature Range Limit	Set temperature range limit for auto, cool (drying) and heat modes.	Each Group	Each Group
Operation Lock Out Function	Locking of ON/OFF, Mode, Set Temp, Hold button and Air Direction.	Each Group	Each Group
Password	User and Service password protections are available	Each Group	N/A
Hold	Hold Prohibits the scheduled operation from being executed a. ON/OFF timer b. Auto-OFF timer c. Weekly timer d. Automatic return to the preset temperature * While an operation is prohibited by Hold function, the operation icon lights up.	Each Group	Each Group

4.05 Centralized Controller (Web-enabled)

A. AE-200 Centralized Controller

The AE-200A Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three (3) AE-50A expansion controllers. The AE-200A Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The AE-200A Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the AE-200A Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the AE-200 Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the AE-200A provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the AE-200A Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

AE-200 (Centralized Controller)			
Item	Description	Operation	Display
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
AE-200 (Centralized Controller)			
Item	Description	Operation	Display
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group

Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group

AE-200 (Centralized Controller)			
Item	Description	Operation	Display
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between "Hi", "Low" and "Stop". When setting a group of only free plan LOSSNAY units, you can switch between "Normal ventilation", "Interchange ventilation" and "Automatic ventilation".	Each Group	Each Group
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: "Batch start/stop", "Batch emergency stop" By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

All AE-200A Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three AE-50A expansion controllers for display of up to two hundred (200) indoor units on the main AE-200A interface.

The AE-200A Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

Standard software functions shall be available so that the building manager can securely log into each AE-200A via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Tenant Billing shall be available but are not included. The Tenant Billing function shall require TG-2000 Integrated System software in conjunction with the Centralized Controllers.

B. AE-50A Expansion Controller

The AE-50A Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the AE-200A Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the AE-200A. Up to three (3) AE-50A expansion controllers can be connected to the AE-200A via a local IP network (and their IP addresses assigned on the AE-200A) to the AE-200A to allow for up to two hundred (200) indoor units to be monitored and controlled from the AE-200A interface.

The AE-50A expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the AE-200A and configured to display their units on the main controller, the individual indoor units connected to the AE-50A can still be monitored and controlled from the interface of the AE-50. The last command entered will take precedence, whether at the wall controller, the AE-50A or the AE- 200A Centralized Controller.

4.06 The following software functions are optional per AE-200/AE-50/EB-50GU:

1. Personal Web Browser (SW-Pweb): The CMCN shall be capable of allowing up to 50 individual users to monitor and control user defined zones via a network PC or MAC's web browser.

Tenant Billing (SW-Charge): The CMCN shall be capable of calculating CITY MULTI energy usage in kWh and in a monetary amount based on the energy consumption of the outdoor unit(s) divided among the associated indoor units per AE-200/AE-50/EB-50GU. This software is used in conjunction with the TG-2000 software a networked PC, and Watt Hour Meters (WHM).

4.07 Graphical User Workstation Software

The Graphical User Workstation Software (TG-2000) shall require a field supplied PC.

A. TG-2000 Software

The TG-2000 Integrated System Software shall enable the user to control multiple AE-200/AE- 50/EB-50GU's and shall provide additional functions such as tenant billing from a single, dedicated network PC configured with the TG-2000 software. The TG-2000 configured computer shall be capable of controlling up to forty AE-200/AE-50/EB-50GU Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The TG-2000 software shall be required if the user wants to simultaneously control more than 1 AE-200/AE-50/EB-50GU Centralized Controllers from a single PC using a single software session. Licensing per function, per AE-200/AE-50/EB-50GU Centralized Controller shall be required for the TG-2000 software. Optional software features shall be available through the TG-2000 software including tenant billing. These optional software features shall require the TG-2000 software, advance purchase from the customer, and licensing from Mitsubishi to enable feature activation.

TG-2000 (Integrated System Software)	
Item	Details
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote
TG-2000 (Integrated System Software)	
Item	Details
	controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF LOSSNAY	If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)

Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportionment Charging	A RS-485 watt-hour meter (WHM) is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Two charging rates can be applied per day. ***OPTIONAL TENANT BILLING SOFTWARE (SW-CHARGE) REQUIRED
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the TG-2000 and is limited to some limited operation items.)
Operation Time Monitor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.
Set Temperature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

4.08 CMCN: System Integration

The CMCN shall be capable of supporting integration with Building Management Systems (BMS).

A. BAC-HD150: BACnet® Interface

4.10 The Mitsubishi Electric Cooling & Heating BACnet® interface, BAC-HD150, shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2004) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address. Power Supply (PAC-SC51KUA)

The power supply shall supply 24VDC (TB3) for the AE-200/AE-50/EB-50GU centralized controller and 30VDC (TB2) voltage for the central control transmission.

Part 6 – Execution

6.01 Installation

A. General:

Rig and install in full accordance with manufacturer's requirements, project drawings, and contract documents. Refer to the manufacturer's installation manual for full requirements.

B. Location:

Locate indoor and outdoor units as indicated on drawings. Provide service clearance per manufacturer's installation manual. Adjust and level outdoor units on support structure.

For climates that experience snowfall, mount the outdoor unit a minimum of 12" above the average snowfall line. In climates where this height requirement proves unfeasible, the outdoor units may be installed at the average snowfall line provided regular snow removal in the area surrounding the units keeps the snow line below the bottom of the units.

C. Components / Piping:

Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer's installation manual for full instructions.

Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.

Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-

specific appurtenances are not allowed.

Refrigerant pipe for CITY MULTI shall be made of phosphorus deoxidized copper, and has two types.

- A. ACR "Annealed": Soft copper pipe, can be easily bent with human's hand.
- B. ACR "Drawn Temper": Hard copper pipe (Straight pipe), being stronger than Type- O pipe of the same radical thickness.

The maximum operation pressure of R410A air conditioner is 4.30 MPa [623psi] . The refrigerant piping should ensure the safety under the maximum operation pressure. Refer to recommend piping specifications in Mitsubishi Electric's engineering manual. Pipes of radical thickness 0.7mm or less shall not be used.

Flare connection should follow dimensions provided in manufacturer's installation manuals.

D. Insulation:

Refrigerant lines, as well as any valves, shall be insulated end to end with ½" closed-cell pipe insulation for piping up to 1" in diameter, or ¾" for piping 1-1/8" and larger, with a thermal conductivity no greater than 0.27 BTU-in/hr sq.ft °F. If state or local codes require insulation other than that specified above, the greater insulation shall be used.

E. Electrical:

Installing contractor shall coordinate electrical requirements and connections for all power feeds with electrical contractor. Refer to Division 26 (Master Format 2004) or Division Section 16 (Master Format 1995) for additional information.

F. Third Party Controls:

Installing contractor shall coordinate all BAS/BMS control requirements and connections with controls contractor.

Part 7 – Service

7.01 Maintenance Tool Software and MN-Converter (CMS-MNG-E)

- A. The Maintenance Tool, via the MN-Converter (CMS-MNG-E), shall enable the user to monitor and record the following parameters in a centralized system.

- i. Outdoor Unit

- 1. Operation Mode (Cooling Only, Heating Only, Cooling Main, Heating Main)
 - 2. Compressor Frequency, amperages, and voltages
 - 3. Compressor high- and low-side pressure
 - 4. System Temperatures
 - 5. Outdoor temperature
 - 6. Status of reversing valve

- ii. BC Controller

- 1. Valve ON/OFF status
 - 2. Temperatures
 - 3. Pressures

- iii. Indoor Unit

- 1. Entering Air Temperature
 - 2. Entering/Leaving Refrigerant Temperature
 - 3. Superheat/Subcool temperatures
 - 4. LEV position
 - 5. Room temperature setpoint
 - 6. Unit Mode and Status (Heat, Cool, Dry, Auto, Fan)

- B. The Maintenance Tool shall have the additional feature of controlling the following system components manually:

- i. Indoor Unit

- 1. Indoor Unit ON/OFF
 - 2. Mode (Heat, Cool, Dry, Auto, Fan)
 - 3. Room Temperature Setpoint
 - 4. Fan speed
 - 5. LEV Position

- ii. BC Controller

- 1. Valve OPEN/CLOSE

2. LEV Position

- C. The Maintenance Tool shall be connectable to either the TB3 or TB7 communication bus lines on the MNET via alligator connectors.
- D. The Maintenance Tool shall be connectable to a PC via a USB cable.
- E. Trended data from Maintenance Tool shall be available to export to a data file for offline analysis.

END OF SECTION 238126

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cabinet unit heaters with centrifugal fans and electric resistance heaters.
 - 2. Electric unit heaters wall mounted.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.
 - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Location and arrangement of piping valves and specialties.
 - 6. Location and arrangement of integral controls.
 - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which unit heaters will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 6. Perimeter moldings for exposed or partially exposed cabinets.
 - D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
 - E. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
 - F. Manufacturer Seismic Qualification Certification: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - G. Field quality-control test reports.
 - H. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- 1.6 EXTRA MATERIALS
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Airtherm; a Mestek Company.
 2. Berko Electric Heating; a division of Marley Engineered Products.
 3. Carrier Corporation.
 4. Chromalox, Inc.; a division of Emerson Electric Company.
 5. Dunham-Bush, Inc.
 6. Engineered Air Ltd.
 7. Indeeco.
 8. International Environmental Corporation.
 9. Markel Products; a division of TPI Corporation.
 10. Marley Electric Heating; a division of Marley Engineered Products.
 11. McQuay International.
 12. Ouellet Canada Inc.
 13. QMark Electric Heating; a division of Marley Engineered Products.
 14. Rosemex Products.
 15. Trane.
 16. USA Coil & Air.
- B. Description: A factory-assembled and -tested unit complying with ARI 440.
 1. Comply with UL 2021.
- C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.
 1. Thickness: 1/2 inch (13 mm).
 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F (0.037 W/m x K at 24 deg C) mean temperature.
 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Coil Section Insulation: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.

1. Thickness: 3/8 inch (9 mm).
 2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F (0.034 W/m x K at 24 deg C) mean temperature.
 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
 4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- E. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- (1.35-mm-) thick, galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- (1.35-mm-) thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 3. Recessing Flanges: Steel, finished to match cabinet.
 4. Control Access Door: Key operated.
 5. Base: Minimum 0.0528-inch- (1.35-mm-) thick steel, finished to match cabinet, 4 inches (100 mm) high with leveling bolts.
 6. Extended Piping Compartment: 8-inch- (200-mm-) wide piping end pocket.
 7. False Back: Minimum 0.0428-inch- (1.1-mm-) thick steel, finished to match cabinet.
- F. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Washable Foam: 70 percent arrestance and 3 MERV.
 2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
 3. Pleated: 90 percent arrestance and 7 MERV.
- G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- H. Fan and Motor Board: Removable.
1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."
 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

- I. Control devices and operational sequences are specified in Division 15 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
 - J. Basic Unit Controls:
 - 1. Control voltage transformer.
 - 2. Unit-mounted thermostat with the following features.
 - a. Heat-off switch.
 - b. Fan on-auto switch.
 - c. Manual fan speed switch.
 - d. Adjustable deadband.
 - e. Concealed set point.
 - f. Concealed indication.
 - g. Deg F (Deg C) indication.
 - 3. Unit-mounted temperature sensor.
 - 4. Unoccupied period override push button.
 - 5. Data entry and access port.
 - a. Input data includes room temperature, and occupied and unoccupied periods.
 - b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.
 - K. Electrical Connection: Factory wire motors and controls for a single field connection.
 - L. Capacities and Characteristics: See schedule.
- 2.2 PROPELLER UNIT HEATERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Airtherm; a Mestek Company.
 - 2. Engineered Air Ltd.
 - 3. Berko.
 - 4. McQuay International.
 - 5. Rosemex Products.
 - 6. Ruffneck Heaters; a division of Lexa Corporation.
 - 7. Trane.
 - B. Description: An assembly including casing, coil, fan, and motor in vertical discharge configuration with adjustable discharge louvers.
 - C. Comply with UL 2021.
 - D. Comply with UL 823.
 - E. Cabinet: Removable panels for maintenance access to controls.
 - F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested

propeller unit heater before shipping.

- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- H. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- I. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.
- J. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.
- K. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- L. Fan Motors: Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Type: Permanently lubricated,.
- M. Control Devices:
 - 1. Unit-mounted fan-speed switch.
 - 2. Unit-mounted summer fan switch
 - 3. Unit-mounted thermostat.
- N. Capacities and Characteristics: See schedule on drawings.

2.3 WALL AND CEILING HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Chromalox, Inc.; a division of Emerson Electric Company.
 - 3. Indeeco.
 - 4. Markel Products; a division of TPI Corporation.
 - 5. Marley Electric Heating; a division of Marley Engineered Products.
 - 6. Ouellet Canada Inc.
 - 7. QMark Electric Heating; a division of Marley Engineered Products.
 - 8. Trane.
- D. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- E. Cabinet:

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- F. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.
- H. Fan: Aluminum propeller directly connected to motor.
1. Motor: Permanently lubricated. Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."
- I. Controls: Unit-mounted thermostat.
- J. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.
- K. Capacities and Characteristics: See schedule on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 15 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors.
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in other sections.
- G. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of unit heater. Steam specialties are specified in other sections.
- H. Ground equipment according to Section "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238239

CODES AND FEES
SECTION 260400

PART 1 GENERAL

1.1 DESCRIPTION

- A. General: Comply with Codes in accordance with the Contract Documents.

1.2 CODES

- A. The electrical installation shall be in compliance with the requirements of O.S.H.A., N.E.C., Local Codes and the rules, regulations and requirements of the power company supplying power to the building.
- B. The electrical installation shall comply fully with all county and state laws, ordinances and regulations applicable to electrical installations.
- C. All equipment shall be equal to or exceed the minimum requirements of N.E.M.A., I.E.E.E. and U.L.

1.3 FEES

- A. All local fees and permits and services of inspection authorizes shall be obtained and paid for by the Contractor. Contractor shall pay for all subcontracted services.

1.4 CERTIFICATE OF INSPECTION

- A. Certificate of Inspection and approval shall be procured and paid for by this Contractor for an independent electrical inspection and delivered to the Owner before final payment is made.

END OF SECTION 260400

**COMMON WORK RESULTS FOR ELECTRICAL
SECTION 260500**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section

"Penetration Firestopping."

- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

**BUILDING WIRE AND CABLE
SECTION 260519**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building wire and cable.
 - 2. Wiring connectors and connections.
- B. RELATED SECTIONS
 - 1. Section 260553 – Electrical Identification.
 - 2. Section 260533 – Raceway and Boxes.

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide for each cable assembly type.
- C. Test Reports: Indicate procedures and values obtained.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

1.6 FIELD SAMPLES

- A. Reserved

1.7 PROJECT CONDITIONS

- A. All conductors shall be copper.
- B. Route wire and cable parallel to building's structural elements and as necessary to meet Project Conditions.
- C. Determine exact routing and lengths required.

1.8 COORDINATION

- A. Coordinate Work under provisions of Division 1.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 MANUFACTURERS - BUILDING WIRE AND CABLE

- A. American Insulated Wire Corporation.
- B. Carol Cable Company.
- C. Rome Cable.

2.2 BUILDING WIRE AND CABLE

- A. Description: Stranded insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70, Type THHN/THWN.

2.3 NON-METALLIC SHEATHED CABLE

- A. Description: Stranded insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70, Type NM

2.4 METAL CLAD CABLE

- A. Description: ANSI/NFPA 70, Type MC.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic, THHN/THWN.
- F. Armor Material: Steel or Aluminum.
- G. Armor Design: Interlocked metal tape.

2.5 Jacket: PVC in locations specified in Article 3.03 WIRING METHODS WIRING CONNECTORS

- A. Split Bolt Connectors:
 - 1. Burndy Corporation.
 - 2. IlSCO.
 - 3. Teledyne Penn Union.
 - 4. Substitutions: Under provisions of Division 1.
- B. Solderless Pressure Connectors:
 - 1. Burndy Corporation.
 - 2. IlSCO.
 - 3. Teledyne Penn Union.
 - 4. Substitutions: Under provisions of Division 1.
- C. Spring Wire Connectors:
 - 1. 3M.
 - 2. Buchanan.
 - 3. Burndy.
 - 4. Substitutions: Under provisions of Division 1
- D. Compression Connectors:
 - 1. Burndy Corporation.
 - 2. IlSCO.
 - 3. Teledyne Penn Union.
 - 4. Substitutions: Under provisions of Division 1.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRE COLOR

- A. General
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black (Phase A), red (Phase B), and blue (Phase C) for circuits at 120/208 volts single or threephase.
 - b. Brown (Phase A), orange (Phase B), and yellow (Phase C) for circuits at 277/480 volts single or threephase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black (Phase A), red (Phase B), and blue (Phase C) for circuits at 120/208 volts single or threephase.
 - b. Brown (Phase A), orange (Phase B), and yellow (Phase C) for circuits at 277/480 volts single or threephase.
 - 3. For ground wire shall be green.

4. For neutral wire shall be white for 120/208 and grey for 277/480 volts.

3.4 WIRING METHODS

- A. Concealed Dry Interior Locations above lay-in ceilings or non block partition walls: Use THHN/THWN insulation, in raceway for home runs. MC cable may be used for branch circuit wiring other than homeruns.
- B. Exposed Dry Interior Locations: Use building wire THHN/THWN insulation in rigid galvanized steel raceway.
- C. Above Accessible Ceilings: Use building wire THHN/THWN insulation in raceway for homeruns. Use metal clad cable for branch circuit wiring other than home runs.
- D. Wet or Damp Interior Locations: Use only building wire Type THHN/THWN insulation in rigid galvanized steel raceway.
- E. Exterior Locations: Use building wire THHN/THWN insulation in RGS raceway.

3.5 INSTALLATION

- A. Install products in accordance with manufacturers instructions.
- B. Use stranded conductors for all feeders and branch circuits.
- C. Use stranded conductors for control circuits.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits.
- E. Use conductor not smaller than 14 AWG for control circuits.
- F. Use one size larger conductors for runs longer than 100 feet.
- G. Pull all conductors into raceway at same time.
- H. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- I. Protect exposed cable from damage.
- J. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- K. Use suitable cable fittings and connectors.
- L. Neatly install wiring inside boxes, equipment, and panelboards.
- M. Clean conductor surfaces before installing lugs and connectors.
- N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- O. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- R. Install wiring concealed in finished spaces. Provide any required fishing and patching where required. Wiring in finished spaces with concrete block walls shall be wired with wiring concealed in the block wall cavity and all devices and fixture boxes set flush with concrete block surfaces. Interior Concealed wiring in block walls shall be schedule 40 PVC or rigid metal raceway. Do not mount boxes or devices in block joints.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 260553.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.7 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- C. Verify continuity of each branch circuit conductor.

END OF SECTION 260519

**GROUNDING AND BONDING
SECTION 260526**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grounding electrodes and conductors.
 - 2. Equipment grounding conductors.
 - 3. Bonding.

1.2 RELATED SECTIONS

- A. Reserved.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 GROUNDING ELECTRODE SYSTEM (As applicable)

- A. Metal underground waterpipe.
- B. Rod electrode.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: Maximum of 5 ohms.

1.6 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 PRODUCTS

2.1 ROD ELECTRODE

- A. Manufacturers:
 - 1. American Electric.
 - 2. Blackburn, Thomas & Betts.
 - 3. Substitutions: Under provisions of Division 1.
- B. Material: Copper
- C. Diameter: 5/8 inch.
- D. Length: 10 feet.

2.2 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. IlSCO Model AGC.
 - 2. Equal by Burndy.
 - 3. Equal by Teledyne Penn Union.
 - 4. Substitutions: Under provisions of Division 1.
- B. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. ERICO Products, Inc. (Cadweld).

2.4 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size as shown on the drawings, if not shown, conductor shall be as required by the local jurisdiction and the utility company.

2.5 GROUNDING WELL COMPONENTS

- A. Test Well Pipe: 12 inch diameter by 24 inch long clay tile or concrete pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install additional rod electrodes as required to achieve the NEC minimum, or the specified resistance to ground.
- C. Provide grounding well pipe with cover at rod locations. Install well pipe top flush with finished grade.
- D. Provide bonding to meet Regulatory Requirements.
- E. Provide isolated grounding conductor for circuits supplying IG receptacles.
- F. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Reserved.

3.4 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall- of- potential method.

END OF SECTION 230533

**ELECTRICAL HANGERS AND SUPPORTS
SECTION 260529**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit and equipment supports.
 - 2. Anchors and fasteners.
- B. REFERENCES
 - 1. NECA - National Electrical Contractors Association.
 - 2. ANSI/NFPA 70 - National Electrical Code.

1.2 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance. All fasteners exposed to a corrosive environment or installed outside shall be stainless steel.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Use expansion anchors and preset inserts.
 - 2. Steel Structural Elements: Use beam clamps, spring steel clips and welded fasteners.
 - 3. Concrete Surfaces: Use expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.

5. Solid Masonry Walls: Use expansion anchors.
6. Sheet Metal: Use sheet metal screws.
7. Wood Elements: Use wood screws.

2.2 STEEL CHANNEL

- A. Manufacturer:
 1. Unistrut Model P1000.
 2. Substitutions: Under provisions of Division 1.
- B. Description: Painted steel.

2.3 SPRING STEEL CLIPS

- A. Manufacturer:
 1. B-line.
 2. Caddy.
 3. Substitutions: Under provisions of Division 1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, suspended ceiling wires and conduit.
- D. Do not use spring steel clips and clamps except on concealed metal studs.
- E. Do not use powder-actuated anchors.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off of wall.
- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- K. Support fixtures independently of ceilings.

END OF SECTION 260529

**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
SECTION 260533**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

- a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Samples for Initial Selection: For surface raceways with factory-applied texture and color finishes.
- D. Samples for Verification: For each type of exposed finish required for surface raceways, prepared on Samples of size indicated below.
- E. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- F. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Qualification Data: For professional engineer and testing agency.
- H. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering

products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflec Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- C. Rigid Steel Conduit: ANSI C80.1.
- D. Aluminum Rigid Conduit: ANSIC80.5.
- E. IMC: ANSI C80.6.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: ANSI C80.3.
- H. FMC: Zinc-coated steel or aluminum.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel or die-cast, compression type.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.

3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

- C. ENT: NEMA TC 13.
- D. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- E. LFNC: UL 1660.
- F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Screw-cover type.
- F. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Robroy Industries, Inc.; Enclosure Division.
 9. Scott Fetzer Co.; Adalet Division.
 10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic.
- I. Cabinets:
 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

2.6 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138- inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.7 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying

with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT or Wiremold (as noted on drawings).
 2. Exposed, Not Subject to Severe Physical Damage: EMT or Wiremold (as noted on drawings).
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT for homeruns and MC Cable may be utilized
 5. Damp or Wet Locations: Rigid steel conduit.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg)T tensile strength. Leave at least 12 inches (300 mm)T of slack at each end of pull wire.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

- O. Set metal floor boxes level and flush with finished floor surface.
- P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270

mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

CABINETS AND ENCLOSURES
SECTION 260535

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hinged cover enclosures.
 - 2. Cabinets.
 - 3. Terminal blocks.
 - 4. Accessories.
- B. RELATED SECTIONS
 - 1. Section 260529 – Electrical Hangers and Supports.

1.2 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratory.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hoffman.
- B. Hammond.
- C. Substitutions: Under provisions of Division 1

2.2 HINGED COVER ENCLOSURES (Includes CT Cabinets)

- A. Construction: NEMA Type 12, steel enclosure.

- B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver, with a hasp and staple for padlock.
- C. Provide interior plywood or threaded metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel, white, beige, or light gray.

2.3 CABINETS

- A. Boxes: Steel with removable endwalls.
- B. Box Size: Per NEC or as required.
- C. Backboard: Provide 3/4 inch thick plywood backboard for mounting terminal blocks, etc. Paint plywood matte white.
- D. Fronts: Steel screw cover front, or concealed hinge, and flush lock. Finish with white or light gray baked enamel.
- E. Knockouts as required.
- F. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- G. Provide accessory feet for free-standing equipment.

2.4 TERMINAL BLOCKS

- A. Provide as required to provide a neat appearance.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify that surfaces are ready to receive Work.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.
- D. Provide enclosures for all electrical control devices such as relays, contactors, etc.

END OF SECTION
260535

**ELECTRICAL IDENTIFICATION
SECTION 260553**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.

1.2 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements: Environmental conditions affecting products on site.

1.7 EXTRA MATERIALS

- A. Division 1 - Execution Requirements: Requirements for extra materials.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Product Description: Laminated three-layer plastic with black engraved letters on contrasting white background color.
- C. Letter Size:
 - 1. **1/8 inch** high letters for identifying individual equipment and loads.
 - 2. **1/4 inch** high letters for identifying grouped equipment and loads.
- D. Minimum nameplate thickness: **1/8 inch**.

2.2 LABELS

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Substitutions: Division 1 - Product Requirements.
- B. Labels: Embossed adhesive tape, with **3/16 inch** black letters on white background.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located

- outside panel with corrosive-resistant mechanical fasteners, or adhesive.
- 4. Secure nameplate to equipment front using adhesive.
- 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations. Install nameplates for the following:
 - a. Switchboards.
 - b. Service Disconnects.
- C. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations, and
 - 3. Install labels for permanent adhesion and seal with clear lacquer.

END OF SECTION 260553

**NETWORK LIGHTING CONTROLS
SECTION 260943**

PART 1 - GENERAL

1.1 Summary

- .1 Section includes a networked lighting control system comprised of the following components:
 - .1 System Software Interfaces
 - .1 Management Interface
 - .2 Visualization Interface
 - .3 Personal Control Applications
 - .4 Smartphone Programming Interface for wired devices
 - .5 Smartphone Programming Interface for wireless devices
 - .2 System Backbone and Integration Equipment
 - .1 System Controller
 - .2 OpenADR Interface
 - .3 Wired Networked Devices
 - .1 Wall Stations
 - .2 Graphic Wall Stations
 - .3 Digital Key Switches
 - .4 Auxiliary Input/Output Devices
 - .5 Occupancy and Photocell Sensors
 - .6 Wall Switch Sensors
 - .7 Embedded Sensors
 - .8 Power Packs and Secondary Packs
 - .9 Networked Luminaires
 - .10 Relay and Dimming Panel
 - .11 Bluetooth® Low Energy Programming Device
 - .12 Communication Bridge

- .2 The networked lighting control system shall meet all the characteristics and performance requirements specified herein, substitutions must be an equal to the specified, no additional monies will be awarded to the contractor to make equal, as determined by the Engineer.
- .3 The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

1.2 Submittals

- .1 Submittal shall be provided including the following items.
 - .1 Bill of Materials necessary to install the networked lighting control system.
 - .2 Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
 - .3 Riser Diagrams PROJECT SPECIFIC showing device wiring connections of system backbone and typical per room/area type.
 - .4 Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
 - .5 Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
 - .6 Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).
 - .7 Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
 - .8 Hardware and Software Operation Manuals.

1.3 Approvals

- .1 Prior approval from owner's representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.
- .2 Any alternate product or system that has not received prior approval from the owner's representative at least 10 days prior to submission of a proposal package shall be rejected.
- .3 Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals to owner's representative.

- .4 For any alternate system that does not support any form of wireless communication to networked luminaires, networked control devices, networked sensors, or networked input devices, bidders shall provide a total installed cost including itemized labor costs for installing network wiring to luminaires, control devices, sensors, input devices and other required system peripherals.

1.4 Quality Assurance

- .1 Product Qualifications
 - .1 System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
 - .2 System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V2.0.
 - .3 System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
 - .4 All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
 - .5 All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- .2 Installation and Startup Qualifications
 - .1 System startup shall be performed by qualified personnel approved or certified by the manufacturer.
- .3 Service and Support Requirements
 - .1 Phone Support: Toll free technical support shall be available.
 - .2 Remote Support: The bidder shall offer a remote support capability.
 - .3 Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
 - .4 Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.5 Project Conditions

- .1 Only install indoor equipment after the following site conditions are maintained:
 - .1 Ambient Temperature: 14 to 105 degrees F (-10 to 40 degrees C)

- .2 Relative Humidity: less than 90% non-condensing
 - .2 Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above or as marked on the product, at any point prior to installation.
 - .3 Only properly rated equipment and enclosures, installed per the manufacturer's instructions, may be subjected to dust and moisture following installation.
- 1.6 **Warranty**
- .1 The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.
 - .2 The hardware warranty shall cover repair or replacement any defective products within the warranty period.
- 1.7 **Maintenance & Sustainability**
- .1 The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

PART 2 - EQUIPMENT

2.1 Manufacturers

- .1 Acceptable Manufacturers
 - .1 Acuity Brands Lighting, Inc.
- .2 Basis of Design System: **Acuity Controls nLight**
- .3 **Substitutions permitted, must be equal or superior to basis of design. Alternate manufacturers must include similar components.**

2.2 System Compliance

- .1 System components shall comply with UL 916 and UL 924 standards where applicable.
- .2 System components shall comply with CFR Title 47, Part 15 standards where applicable.
- .3 System components shall comply with ISED Canada RSS-247 standards where applicable.
- .4 All equipment shall be installed and connected in compliance with NFPA 70.

2.3 System Performance Requirements

- .1 System Architecture

- .1 System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation.
- .2 Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
- .3 System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see *Control Zone Characteristics* sections for each type of network connection, wired or wireless).
- .4 Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
- .5 Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”
 - .1 Lighting control zones (wired and wireless) of at least 128 devices per zone shall be supported.
- .6 Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.
- .7 Lighting control zones shall be capable of being networked with a higher-level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
- .8 The system may include one or more system controllers that provide time-based control. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
- .9 All system devices shall support firmware update, either remotely or from within the applications space, for purposes of upgrading functionality at a later date.

.2 Wired Networked Control Zone Characteristics

- .1 Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide cost savings, the use of mixed types of low voltage network cables shall not be permitted.
- .2 Devices in an area shall be connected via a “daisy-chain” topology; requiring all individual networked devices to be connected back to a central component in a “hub-and-spoke” topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.
- .3 System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.
- .4 Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g. software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
- .5 Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
- .6 All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.
- .7 Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - .1 Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
 - .2 UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay and provide 100% light output upon detection of loss of power sensed via line voltage connection to normal power.

- .8 Networked luminaires and intelligent lighting control devices located in different areas shall be able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. Occupancy and photocell commands shall be available across a single controller, and switch commands shall be available across single or multiple controllers. These shall also be referred to as global control zones.
- .9 Wired networked Wall stations shall provide the follow Scene Control Capabilities:
 - .1 Preset Scenes that can activate a specific combination of light levels across multiple local and global channels, as required.
 - .2 Profile Scenes that can modify the sequence of operation for the devices in the area (group) in response to a button press. This capability is defined as supporting "Local Profiles" and is used to dynamically optimize the occupant experience and lighting energy usage. Wall stations shall be able to manually start and stop Local Profiles, or the local profile shall be capable of ending after a specific duration of time between 5 minutes and 12 hours. Parameters that shall be configurable and assigned to a Local Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.
 - .3 3-way / multi-way control: multiple wall stations shall be capable of controlling the same local and global control zones, so as to support "multi-way" preset scene and profile scene control.
- .3 System Integration Capabilities
 - .1 The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet MS/TP protocols. The following system integration capabilities shall be available via BACnet/IP and BACnet MS/TP protocols:
 - .1 The system shall support control of individual devices, including, but not limited to, control of relay and dimming output.
 - .2 The system shall support reading of individual device status information. The available status will depend on the individual device type and capabilities, which may include but not be limited to, relay state, dimming output, power measurement, occupancy sensor status, and photocell sensor states or readings. All system devices shall be available for polling for devices status.
 - .3 The system shall support activation of pre-defined system Global Profiles (see *Supported Sequence of Operations* for further definition of *Global Profile capabilities*).

- .2 The system shall support activation of Global Profiles from third party systems by receiving dry contact closure output signals or digital commands via RS-232/RS-485. (See *Supported Sequence of Operations* for further definition of Profile and Scene Preset capabilities.)
- .3 The system shall support activation of demand response levels from Demand Response Automation Servers (DRAS) via the OpenADR 2.0a protocol.
- .4 Supported Sequence of Operations
 - .1 Control Zones
 - .1 Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) shall be capable of transmitting and tracking occupancy sensor, photocell sensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within the area. These shall also be referred to as local control zones.
 - .2 Wall station Capabilities
 - .1 Wall stations shall be provided to support the following capabilities:
 - .1 On/Off of a local control zone.
 - .2 Continuous dimming control of light level of a local control zone.
 - .2 3-way / multi-way control: multiple wall stations shall be capable of controlling the same local control zones, so as to support “multi-way” switching and/or dimming control.
 - .3 Occupancy Sensing Capabilities
 - .1 Occupancy sensors shall be configurable to control a local zone.
 - .2 Multiple occupancy sensors shall be capable of controlling the same local zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.
 - .3 System shall support the following types of occupancy sensing sequence of operations:
 - .1 On/Off Occupancy Sensing
 - .2 Partial-On Occupancy Sensing
 - .3 Partial-Off Occupancy Sensing
 - .4 Vacancy Sensing (Manual-On / Automatic-Off)
 - .4 On/Off, Partial-On, and Partial-Off Occupancy Sensing modes shall function according to the following sequence of operation:

- .1 Occupancy sensors shall automatically turn lights on to a designated level when occupancy is detected. To support fine tuning of Partial-On sequences the designated occupied light level shall support at least 100 dimming levels.
 - .2 Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
 - .3 To provide additional energy savings the system shall also be capable of combining Partial-Off and Full-Off operation by dimming the lights to a designated level when vacant and then turning the lights off completely after an additional amount of time.
 - .4 Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under *Photocell Sensing Capabilities*.
 - .5 The use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
- .5 Vacancy Sensing mode (also referred to as Manual-On / Automatic-Off) shall function according to the following sequence of operation:
- .1 The use of a wall station is required turn lights on. The system shall be capable of programming the zone to turn on to either to a designated light level or the previous user light level. Initially occupying the space without using a wall station shall not result in lights turning on.
 - .2 Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
 - .3 To provide additional energy savings and an enhanced occupant experience, the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.

- .4 To minimize occupant impact in case the area or zone is still physically occupied following dimming or shutoff of the lights due to detection of vacancy, the system shall support an “automatic grace period” immediately following detection of vacancy, during which time any detected occupancy shall result in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is required to turn lights on.
- .5 Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under *Photocell Sensing Capabilities*.
- .6 At any time, the use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
- .6 To accommodate diverse types of environments, occupancy time delays before dimming or shutting off lights shall be specifiable for control zones between 15 seconds to 2 hours.
- .4 Photocell Sensing Capabilities (Automatic Daylight Sensing)
 - .1 Photocell sensing devices shall be configurable to control a local zone.
 - .2 The system shall support the following type of photocell-based control:
 - .1 Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.
- .5 Schedule and Global Profile Capabilities
 - .1 The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, manually triggered wired wall station input, RS-232/RS-485 command to wired input device, and BACnet input command. This capability is defined as supporting “Global Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage.
 - .2 Global profiles may be scheduled with the following capabilities:

- .1 Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
 - .2 Global Profile time of day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after "n" recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
 - .3 Global Profile Holiday Schedules should follow recurrent settings for specific US holiday dates regardless if they always occur on a specific date or are determined by the day/week of the month.
 - .4 Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
 - .5 System shall support blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible "blink warning" 5 minutes prior to the end of the schedule. Wall stations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.
 - .6 Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.
- .3 System Global Profiles shall have the following additional capabilities:
- .1 Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed wired input devices, scene capable wired wall stations, and the software management interface.
 - .2 Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.
 - .3 Parameters that shall be configurable and assigned to a Global Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.

- .4 A backup of Local and Global Profiles shall be stored on the software's host server such that the Profile backup can be applied to a replacement system controller or wired wall station.
- .6 System shall support automated demand response capabilities with automatic reduction of light level to at least three levels of demand response.

2.4 System Software Interfaces

- .1 Management Interface
 - .1 System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
 - .2 Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
 - .3 Management interface shall require all users to login with a User Name and Password, and shall support creation of at least 100 unique user accounts.
 - .4 Management interface shall support at least three permission levels for users: read-only, read & change settings, and full administrative system access.
 - .5 Management interface shall be capable of restricting access for user accounts to specific devices within the system.
 - .6 All system devices shall be capable of being given user-defined names.
 - .7 The following device identification information shall be displayed in the Management interface: model number, model description, serial number or network ID, manufacturing date code, custom label(s), and parent network device.
 - .8 Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Profiles.
 - .9 Management interface shall be able to read the current active settings of a networked luminaire or intelligent control device and shall be capable of displaying dimming trim levels, occupancy sensor and photocell enable/disable, occupancy sensor time delay and light level settings, occupancy sensor response (normal or vacancy), and photocell setpoints and transition time delays.
 - .10 Management interface shall be able to change the current active settings and default settings for an individual networked luminaire or intelligent control device.

- .11 Management interface shall be capable of applying settings changes for a zone of devices or a group of selected devices using a single "save" action that does not require the user to save settings changes for each individual device.
- .12 A printable network inventory report shall be available via the management interface.
- .13 A printable report detailing all system profiles shall be available via the management interface.
- .14 All sensitive information stored by the software shall be encrypted.
- .15 All system software updates must be available for automatic download and installation via the internet.
- .2 Visualization and Programming Interfaces
 - .1 System shall provide an optional web-based visualization interface that displays graphical floorplan.
 - .2 Graphical floorplan shall offer the following types of system visualization:
 - .1 Full Device Option - A master graphic of the entire building, by floor, showing each control device installed in the project with zones outlined. This shall include, but not be limited to, the following:
 - .1 Controls embedded light fixtures
 - .2 Controls devices not embedded in light fixtures
 - .3 Daylight Sensors
 - .4 Occupancy Sensors
 - .5 Wall Switches and Dimmers
 - .6 Scene Controllers
 - .7 Networked Relays
 - .8 Wired Bridges
 - .9 System Controllers
 - .10 Wired Relay Panels
 - .11 Group outlines
 - .2 Group Only Option - A master graphic of the entire building, by floor, showing only control groups outlined.

- .3 Allow for pan and zoom commands so smaller areas can be displayed on a larger scale simply by panning and zooming each floor's master graphic.
- .4 A mouse click on any control device shall display the following information (as applicable):
 - .1 The device catalog number.
 - .2 The device name and custom label.
 - .3 Device diagnostic information.
 - .4 Information about the device status or current configuration is available with an additional mouse click.
- .3 Personal Control Applications for Wired Devices
 - .1 Software interface shall support personal control software applications that provide user-specific control of individual luminaires/control devices, control zones, global scene presets, and scene selector virtual button presses.
 - .2 The system administrator shall be capable of defining personal control permissions for each user account.
 - .3 Software interface shall provide a Microsoft Windows® operating system taskbar application for personal lighting control.
 - .4 Software interface shall provide an Apple iOS® operating system application (supported by mobile phones and mobile tablet devices) for personal lighting control.
- .4 Smartphone Programming Interface for Wired Devices
 - .1 Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.
 - .2 The application shall support the configuration and control of wired networked control devices via a Bluetooth® Low Energy (BLE) Programming Device.
 - .1 Application shall support a security pin-code to access the zone of lighting control devices.
 - .2 The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.
 - .3 The application shall indicate the number of wired networked control devices connected to the local daisy-chain zone.
 - .4 The application shall provide on/off/dimming control of all control groups.

- .5 The application shall provide the ability to identify all individual luminaires and control devices.
- .3 Programming capabilities through the application shall include, but not be limited to, the following:
 - .1 Switch/occupancy/photosensor zone configuration
 - .2 Manual/automatic on modes
 - .3 Turn-on dim level
 - .4 Occupancy sensor time delays
 - .5 Dual technology occupancy sensors sensitivity
 - .6 Photosensor calibration adjustment and auto-setpoint
 - .7 Multiple photosensor zone offset
 - .8 Trim level settings
 - .9 Preset scene creation and copy for scene capable devices.
 - .10 Application of custom device labels to the Bluetooth Low Energy Programming Devices and individual connected lighting control devices.
 - .11

2.5 System Backbone and System Integration Equipment

- .1 System Controller
 - .1 System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
 - .2 System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.
 - .3 System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases.
 - .4 System Controller shall perform the following functions:
 - .1 Time-based control of downstream wired and wireless network devices.
 - .2 Linking into an Ethernet network.
 - .3 Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.

- .4 Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.
- .5 System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
- .6 Device shall have option for a graphical touch screen to support configuration and diagnostics.
- .7 Device shall have three RJ-45 networked lighting control ports for connection to any of the following:
 - .1 The graphical touch screen
 - .2 Wired communication bridges
 - .3 Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port)
- .8 Device shall automatically detect all networked devices connected to it.
- .9 Device shall have an internal time clock used for astronomical and standard schedules.
- .10 Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection.
 - .1 Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices.
 - .2 Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.
- .11 Device shall have 2 x USB 2.0 Expansion ports for 802.11 Wi-Fi Adapter enabling wireless connectivity including:
 - .1 Hot Spot
 - .2 Access Point
 - .3 Client
- .12 Each System Controller shall be capable of managing and operating at least 750 networked devices (wired or wireless).
 - .1 Multiple System Controllers may be networked together via LAN connection to scale the system up to 20,000 networked devices.
- .13 System Controller shall support BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

- .1 BACnet MS/TP shall support 9600 to 115200 baud rate.
 - .2 System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- .14 System controller shall contain a "FIPS 140-2 Level 1 Inside" cryptographic module.
- .15 System controller shall be available within a NEMA 1 enclosure with Class 1 and Class 2 separation
 - .1 Enclosure shall support power input power of 120-277VAC, or optional 347VAC
- .2 OpenADR Interface
 - .1 System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
 - .2 OpenADR interface shall meet all the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:
 - .1 Programmable with the account information of the end-user's electrical utility DRAS account credentials.
 - .3 OpenADR interface shall support the activation of demand response levels defined in the utility demand response program.

2.6 Wired Networked Devices

- .1 Wired Networked Wall Switches, Dimmers, Scene Controllers
 - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
 - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - .3 All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
 - .4 Devices with mechanical push-buttons shall provide tactile and LED user feedback.
 - .5 Devices with mechanical push-buttons shall be made available with custom button labeling.
 - .6 Wall switches & dimmers shall support the following device options:
 - .1 Number of control zones: 1, 2 or 4

- .2 Control Types Supported:
 - .1 On/Off
 - .2 On/Off/Dimming
 - .3 On/Off/Dimming/Correlated Color Temperature Control for specific luminaire types
- .3 Colors: Ivory, White, Light Almond, Gray, Black, Red
- .7 Scene controllers shall support the following device options:
 - .1 Number of scenes: 1, 2 or 4
 - .2 Control Types Supported:
 - .1 On/Off
 - .2 On/Off/Dimming
 - .3 Preset Level Scene Type
 - .4 On/Off/Dimming/Preset Level for Correlated Color Temperature
 - .5 Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
 - .6 Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
 - .3 Colors: Ivory, White, Light Almond, Gray, Black, Red
- .2 Wired Networked Graphic Wall Stations
 - .1 Device shall surface mount to single-gang switch box.
 - .2 Device shall have a 3.5" full color touch screen.
 - .3 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
 - .4 Device shall have a micro-USB style connector for local computer connectivity.
 - .5 Communication shall be over standard low voltage network cabling with RJ-45 connectors.

- .6 Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.
- .7 Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
- .8 Graphic wall stations shall support the following device options:
 - .1 Number of control zones: Up to 16
 - .2 Number of scenes: Up to 16
 - .3 Profile type scene duration: User configurable from 5 minutes to 12 hours
 - .4 Colors: Ivory, White, Light Almond, Gray, Black
- .3 Wired Networked Digital Key Switches
 - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
 - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - .3 All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
 - .4 Devices shall have LED user feedback to provide indication of on/off status of the programmed lights or scene, as well as indication of device power.
 - .5 Digital key switches shall support the following device options:
 - .1 Control Types Supported:
 - .1 On/Off
 - .2 On/Off/Dimming
 - .3 Preset Level Scene Type
 - .4 Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
 - .5 Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.

- .2 Colors: Ivory, White, Light Almond, Stainless Steel
- .4 Wired Networked Auxiliary Input / Output (I/O) Devices
 - .1 Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
 - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - .3 Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
 - .1 Contact closure or Pull High input
 - .1 Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, activate lights at a preconfigured level, ramp light level up or down, or toggle lights on/off.
 - .2 0-10V analog input
 - .1 Input shall be programmable to function as a daylight sensor.
 - .3 RS-232/RS-485 digital input
 - .1 Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
 - .4 0-10V dimming control output, capable of sinking up to 20mA of current
 - .1 Output shall be programmable to support all standard sequence of operations supported by system.
 - .5 Digital control output via EldoLED LEDcode communication
 - .1 Output shall be programmable to support light intensity control, as well as optional correlated color temperature (CCT) control, of the connected luminaire.
- .5 Wired Networked Occupancy and Photosensors
 - .1 Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 - .2 Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

- .3 For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
- .4 Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
- .5 All sensing technologies shall be acoustically passive, meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- .6 System shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.
- .7 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
- .8 All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
- .9 Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
- .10 Ceiling mount occupancy sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
- .11 Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
- .12 Sensors shall have optional features for photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
- .13 Photosensor shall provide for an on/off set-point, and a dead band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
- .14 Photosensor and dimming sensor's set-point and dead band shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

- .15 Dead band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
- .16 A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an "offset" from the primary zone.
- .6 Wired Networked Wall Switch Sensors
 - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
 - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
 - .3 All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
 - .4 Devices with mechanical push-buttons shall provide tactile user feedback.
 - .5 Wall switches sensors shall support the following device options:
 - .1 User Input Control Types Supported: On/Off or On/Off/Dimming
 - .2 Occupancy Sensing Technology: PIR only or Dual Tech acoustic
 - .3 Daylight Sensing Option: Inhibit Photosensor
 - .4 Colors: Ivory, White, Light Almond, Gray, Black, Red
- .7 Wired Networked Embedded Sensors
 - .1 Network system shall have embedded sensors consisting of occupancy sensors and/or dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
 - .2 Occupancy sensor detection pattern shall be suitable for 7.5' to 20' mounting heights.
 - .3 Embedded sensors shall support the following device options:
 - .1 Occupancy Sensing technology: PIR only or Dual Tech acoustic
 - .2 Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
- .8 Wired Networked Power Packs and Secondary Packs

- .1 Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
- .2 Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
- .3 Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power.
- .4 Power Supplies shall provide system power only, but are not required to switch line voltage circuit.
- .5 Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
- .6 Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
- .7 Power Pack programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
- .8 Power Pack shall securely mount through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- .9 When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- .10 Power/Secondary Packs shall be available with the following options:
 - .1 Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100mA of sink current.
 - .2 Secondary Pack with UL924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
 - .3 Power and Secondary Packs capable of full 20-Amp switching of general purpose receptacle (plug-load) control.
 - .4 Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.

- .5 Secondary Pack capable of 5-Amps switching and dimming 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
 - .6 Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.
 - .7 Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.
 - .8 Secondary Pack capable of louver/damper motor control for skylights.
 - .9 Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
 - .10 Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).
 - .11 Power Supply capable of providing auxiliary bus power (no switched or dimmed load).
- .9 Wired Networked Luminaires
- .1 Networked luminaire shall have a mechanically integrated control device.
 - .2 Networked LED luminaire shall have two RJ-45 ports available (via control device directly or incorporated RJ-45 splitter).
 - .3 Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers).
 - .4 Networked LED luminaire shall provide low voltage power to other networked control devices (excluding EMG and CCT capable versions).
 - .5 System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports "sleep mode."
 - .6 System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
 - .1 System shall indicate (via a blink warning) when the LED luminaire is no longer able to compensate for lumen depreciation.
 - .7 System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
 - .8 System shall be able to provide control of network luminaire intensity, in addition to dynamic features, such as grayscale and color accent of specific LED luminaires.

- .10 Wired Networked Relay and Dimming Panel
 - .1 Relay and dimming panel shall be available with 4, 8, 12, 16, 24, 32, 40 or 48 individual relays per panel, with an equal number of individual 0-10V dimming outputs.
 - .2 Optional Field Configurable Relays (FCR) used shall have the following required properties:
 - .1 Configurable in the field to operate with single-, double-, or triple-pole relay groupings.
 - .2 Configurable in the field to operate with normally closed or normally open behavior.
 - .3 Provides visual status of current state and manual override control of each relay.
 - .4 Listed for the following minimum ratings:
 - .1 40A @ 120-480VAC Ballast
 - .2 16A @ 120-277VAC Electronic
 - .3 20A @ 120-277VAC Tungsten
 - .4 20A @ 48VDC Resistive
 - .5 2HP @ 120VAC
 - .6 3HP @ 240-277VAC
 - .7 65kA SCCR @ 480VAC
 - .3 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
 - .4 Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.
 - .5 Panel shall be UL924 listed for control of emergency lighting circuits.
 - .6 Panel shall power itself from an integrated 120-277 VAC or optional 347VAC supply.
 - .7 Panel shall provide a configurable low-voltage sensor input with the following properties:
 - .1 Configurable to support any of the following input types:
 - .1 Indoor Photocell
 - .2 Outdoor Photocell

- .3 Occupancy Sensor
- .4 Contact Closure
- .2 Low voltage sensor input shall provide +24VDC power for the sensor so that additional auxiliary power supplies are not required.
- .3 Sensor input supports all standard sequence of operations as defined in this specification.
- .8 Panel shall provide a contact closure input for each group of 8-relays that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel. This input is intended to provide an interface to alarm systems, fire panels, or BMS system to override the panel.
- .9 Panel shall supply current limited low voltage power to other networked devices connected via low voltage network cable.
- .10 Panel shall be available with NEMA 1 rated enclosure with the following mounting and cover options:
 - .1 Surface-mounted for all panel sizes
 - .2 Flush-mounted for up to 16 relay panel sizes
 - .3 Screw-fastened for up to 16 relay panel sizes
 - .4 Hinged cover with keyed lock for all panel sizes
- .11 Surface-mounted screw cover options for 8 and 16 relay panel sizes shall be plenum rated
- .12 Panel shall be rated from 0-50C for 8 and 16 enclosure sizes, and 0-45C for 32 and 48 enclosure sizes.
- .11 Wired Networked Bluetooth® Low Energy Programming Device
 - .1 Device shall be plenum rated and be inline wired, screw mountable.
 - .2 Communication and low voltage power shall be delivered to device via standard low voltage network cabling with RJ-45 connectors.
 - .3 Bluetooth Low Energy connection shall allow connection from smartphone application for programming device settings within the local daisy-chain zone (*see list of available settings in section 2.4-System Software Interfaces, Sub-section E*).
 - .1 Device shall provide visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.
- .12 Wired Networked Communication Bridge

- .1 Device shall surface mount to a standard 4" x 4" square junction box.
- .2 Device shall have 8 RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.
- .3 Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
- .4 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply, or powered via low voltage network connections from powered lighting control devices (e.g. power packs).
- .5 Wired Bridge shall be capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

PART 3 - EXECUTION

3.1 Installation Requirements

- .1 Installation Procedures and Verification
 - .1 The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
 - .2 The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
 - .3 The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
 - .1 Wire Map (continuity, pin termination, shorts and open connections, etc.)
 - .2 Length
 - .3 Insertion Loss
- .2 Coordination with Owner's IT Network Infrastructure
 - .1 The successful bidder is required to coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.
 - .1 The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.

- .2 The bidder shall provide to the manufacturer's representative all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- .3 Documentation and Deliverables
 - .1 The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.
 - .2 The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:
 - .1 As-Built floor plan drawings showing device address locations required above. All documentation shall remain legible when reproducing/scanning drawing files for electronic submission.
 - .2 As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
 - .1 CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
Titleblock
Text- Inclusive of room names and numbers, fixture tags and drawings notes
Fixture wiring and homeruns
Control devices
Hatching or poché of light fixtures or architectural elements
 - .2 CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

3.2 System Startup

- .1 Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed.
 - .1 For CAT5 wired devices, low voltage network cable testing shall be performed prior to system startup.
- .2 System start-up and programming shall include:
 - .1 Verifying operational communication to all system devices.

- .2 Programming the network devices into functional control zones to meet the required sequence of operation.
- .3 Programming and verifying all sequence of operations.
- .3 Initial start-up and programming is to occur on-site.

3.3 Project Turnover

- .1 System Documentation
 - .1 Submit software database file with desired device labels and notes completed. Changes to this file will not be made by the factory.
 - .2 Installing contractor to grant access to the owner for the programming database, if requested.
- .2 Owner Training
 - .1 Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION 26094

**PANELBOARDS
SECTION 262442**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards, and load centers.
- B. Related Sections:
 - 1. Division 26 - Grounding and Bonding.
 - 2. Division 26 - Electrical Identification

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 6. NEMA PB 1 - Panelboards.
 - 7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 - Safety for Panelboards.
 - 2. UL 1283 - Electromagnetic Interference Filters.
 - 3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch

arrangement and sizes.

- C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Closeout Submittals: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.6 MAINTENANCE MATERIALS

- A. Division 1 - Execution Requirements and Operation and Maintenance Data: Requirements for maintenance products.
- B. Furnish two of each panelboard key. Panelboards keyed alike.

PART 2 PRODUCTS**2.1 DISTRIBUTION PANELBOARDS**

- A. Manufacturers:
 - 1. Same as MDP manufacturer.
 - 2. Substitutions: Not Permitted.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
- G. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 22,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
- H. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.

- I. Enclosure: NEMA PB 1, Type 1.
Cabinet Front: Surface (in mechanical and electrical rooms only) or recessed type, fastened with concealed trim clamps, door-in-door construction, metal directory frame, finished in manufacturer's standard enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. Same as MDP manufacturer.
 - 2. Substitutions: Not Permitted.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard and furnish insulated ground bus.
- D. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- F. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
- G. Enclosure: NEMA PB 1, Type 1.
- H. Cabinet Box: 5 inches deep, 20 inches wide.
- I. Cabinet Front: Flush or Surface (in mechanical/electrical rooms only) cabinet front with concealed trim clamps, door-in-door construction, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard enamel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.

- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with Division 16.
- H. Install spare conduits out of each recessed panelboard to accessible location [above ceiling or below floor. Minimum spare conduits: 2 empty 1-1/2 inch, 3 empty 1 inch . Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Division 16. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

- A. Division 1 - Quality Requirements: Testing and Inspection Services; Execution Requirements: Testing, adjusting, and balancing.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.3 ADJUSTING

- A. Division 1 - Execution Requirements; Starting and Adjusting: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 262442

**WIRING DEVICES
SECTION 262726**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Device plates and decorative box covers.
- B. RELATED SECTIONS
 - 1. Section 260533 – Raceway and Boxes.

1.2 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

- A. Division 1 - Submittals: Procedures for submittals.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Coordinate color of all devices and cover plates with the Architect.

1.4 SUBMITTALS FOR INFORMATION

- A. Division 1 - Submittals: Submittals for information.
- B. Submit manufacturer's installation instructions.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Single Pole Switch:
 - 1. Hubbell Model HBL1221-X (X=color per Architect).
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- B. Double Pole Switch:
 - 1. Hubbell Model HBL1222-X (X=color per Architect).
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- C. Three-way Switch:
 - 1. Hubbell Model HBL1223-X (X=color per Architect).
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- D. Four-way Switch:
 - 1. Hubbell Model HBL1224-X (X=color per Architect).
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- E. Indicator Switch:
 - 1. Hubbell Model HBL1221-PL.
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- F. Locator Switch:
 - 1. Hubbell Model HBL1221-ILC.
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- G. Keyed Switch:
 - 1. Hubbell Model HBL1221-L w/Key.
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- H. Substitutions: Refer to Division 1.
- I. Color: Per Architect.
- J. Ratings:
 - 1. Voltage: 120-277 volts, AC, except pilot lit and indicator switches shall have a voltage matching the load served.
 - 2. Current: 20 amperes.
 - 3. Match branch circuit and load characteristics.

2.2 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Hubbell Model 5361-X (X = color by Architect).
 - 2. Equal by Bryant.

- 3. Equal by Pass & Seymour.
- B. Duplex Convenience Receptacle:
 - 1. Hubbell Model 5362-X (X= color per Architect).
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- C. GFCI Receptacle:
 - 1. Hubbell Model GF-5362-X (X= color per Architect).
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- D. Special Purpose Receptacle:
 - 1. Hubbell Model to match load and phase requirements.
 - 2. Equal by Bryant.
 - 3. Equal by Pass & Seymour.
- E. Substitutions: Refer to Division 1.
- F. Color: Per Architect.
- G. Description: Commercial grade, 120 volt, 20 ampere, general use receptacle.
- H. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Decorative Cover Plate: Provide stainless steel cover plates in unfinished areas and on block walls unless instructed otherwise by the project architect. In finished areas provide nylon plates with color to match associated devices.
 - 1. Bryant
 - 2. Hubbell
 - 3. Mulberry
 - 4. Substitutions: Refer to division 1.
- B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device cover.
 - 1. Appleton.
 - 2. Raco.
 - 3. O/Z Gendey.
 - 4. Substitutions: Refer to Division 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

- D. Verify that openings in access floor are in proper locations.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top.
- E. Connect wiring device grounding terminal to outlet box with bonding jumper connected to box and branch circuit equipment grounding conductor.
- F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. In equipment rooms use jumbo size plates for outlets installed in masonry walls.
- I. Install stainless steel plates on outlet boxes and junction boxes in unfinished areas, kitchens, above accessible ceilings, and on surface mounted outlets.
- J. Install protective rings on active flush cover service fittings.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260533 to obtain mounting heights specified and as indicated on the drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above counter or backsplash of counter, or as specified on the drawings.
- E. Install telephone and cable boxes 18 inches above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 48 inches above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Division 1 - Quality Control.

- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify that each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.
- G. Verify that each telephone jack is properly connected and circuit is operational.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

**WIRING CONNECTIONS
SECTION 262800**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. Related Sections:
 - 1. Section 260519 - Building Wire and Cable.
 - 2. Section 260533 - Raceway and Boxes.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Submittal procedures.
- B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- F. Install terminal block jumpers to complete equipment wiring requirements.
- G. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

- A. Division 1 - Execution Requirements: Testing, adjusting, and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION 262800

**MOTORS
SECTION 262810**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes single- and three-phase motors for application on equipment provided under other sections.
- B. Related Sections:
 - 1. Section 260553 - Electrical Identification

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Testing Agency: Company specializing in testing products specified in this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

- D. For extended outdoor storage, remove motors from equipment and store separately.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS FORMOTORS FURNISHED WITH EQUIPMENT

- A. Motors 1 hp and Larger: Three-phase motor as specified below.
- B. Motors Smaller Than 1/2 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- C. Three-Phase Motors: High efficiency squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings. Provide high efficiency, inverter duty type motors for use with variable frequency drives. All pump motors shall be non-overloading.
 - 1. Voltage: 208 and 460 volts, three phase, 60 Hz.
 - 2. Service Factor: Minimum of 1.15
 - 3. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings.
 - 4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 5. Insulation System: NEMA Class F.
 - 6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
 - 8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
 - 9. Sound Power Levels: Conform to NEMA MG 1.
- D. Single Phase Motors:
 - 1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
 - 2. Voltage: 115 volts, single phase, 60 Hz.
- E. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned motors
- B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

- A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- B. Install engraved plastic nameplates in accordance with Section 260553.
- C. Ground and bond motors in accordance with Section 260526.

3.3 FIELD QUALITY CONTROL

- A. Division 1 - Execution Requirements: Testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION 262810

FUSES
SECTION 262813

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fuses.
 - 2. Spare fuse cabinet.
- B. RELATED SECTIONS
 - 1. Division 9 - Painting: Painting of spare fuse cabinet.

1.2 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide data sheets showing electrical characteristics including time-current curves.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual fuse sizes.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL.

1.7 MAINTENANCE MATERIALS

- A. Provide one fuse puller.

1.8 EXTRA MATERIALS

- A. Provide three extra of each size and type fuse installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann
- B. Gould Shawmut
- C. Littlefuse, Inc.

2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Main Service Switches: N/A.
- D. Power Load Feeder Switches: Class RK5 time delay.
- E. Motor Load Feeder Switches: Class RK5 time delay.
- F. Other Feeder Switches: Class RK5 time delay.
- G. Motor Branch Circuits: Class RK5 timedelay.

2.3 CLASS RK1 (TIME DELAY) FUSES

- A. Manufacturers:
 - 1. Bussman Model LPS.
 - 2. Equal by Gould Shawmut
 - 3. Equal by Littlefuse, Inc.

2.4 CLASS RK5 (TIME DELAY) FUSES

- A. Manufacturers:
 - 1. Bussmann Model FRS-R (FRN-R for 250 volts).
 - 2. Equal by Gould Shawmut.
 - 3. Equal by Littlefuse, Inc.

2.5 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified. Pre-finished or field painted by E.C.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

- C. Install spare fuse cabinet in the main electrical room.

END OF SECTION 262813

**ENCLOSED SWITCHES
SECTION 262816**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. fusible switches
 - 2. nonfusible switches.
- B. Related Sections:
 - 1. Section 262813 - Fuses.

1.2 REFERENCES

- A. NEMA KS 1 - Enclosed Switches.
- B. NFPA 70 - National Electrical Code.
- C. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
- D. UL 198E - Class R Fuses.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide switch ratings and enclosure dimensions.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cutler Hammer Series DH.
- B. Equal by Square D.
- C. Equal by GE.

2.2 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type Heavy Duty (HD) load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior and wet Locations: Type 3R.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in fusible disconnect switches and fused combination motor starters.
- B. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION 262816

**ENGINE GENERATORS
SECTION 263213**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in applications with the features as specified and indicated where the engine generators will be used as the Standby power source for the system.

1.3 DEFINITIONS

- A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.
- B. Prime Power (PRP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a variable electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the PRP unless otherwise agreed by the RIC engine manufacturer.
- C. Limited Time running Power (LTP): Per ISO 8528: The maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers.
- D. Continuous Operating Power (COP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a constant electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer.
- E. Data Center Continuous (DCC): The maximum power which a generating set is capable of delivering continuously whilst supplying a variable or constant electrical load when operated for an unlimited number of hours in a data center application under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 100 percent of the DCC rating.

- F. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
1. Thermal damage curve for generator.
 2. Time-current characteristic curves for generator protective device.
 3. Sound test data, based on a free field requirement.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for No Preference.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control test reports.
1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
 2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
 3. List of factory tests to be performed on units to be shipped for this Project.
 4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.
- B. Warranty:
1. Submit manufacturer's warranty statement to be provided for this Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within pgh of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 0.0 deg C (32.0 deg F) to 32.22 deg C (90.0 deg F).
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level

1.8 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product and twelve (12) months for Prime/Continuous product from registered commissioning and start-up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The basis for this specification is Cummins Power Generation equipment, approved equals may be considered if equipment performance is shown to meet the requirements herein.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:

1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 175.0kW, at 80 percent lagging power factor, 277/480, Series Wye, Three phase, 4 - wire, 60 hertz.
2. Alternator shall be capable of accepting maximum 100.0 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: (For engine-generator sets using a PMG-excited alternator) For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the

engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

- A. Fuel: ASTM D975 #2 Diesel Fuel
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
 - 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 - 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions
- E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- F. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- G. Cooling System: Closed loop, liquid cooled
 - 1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
 - 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- H. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- I. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- J. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
 6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

- e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
- f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be listed and labeled. The fuel tank shall include the following features:
 - 1. Capacity: Fuel for 24 Hour(s) continuous operation at 100 percent rated poweroutput.
 - 2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
 - 3. Electrical stub up(s)
 - 4. Normal & emergency vents
 - 5. Lockable fuel fill
 - 6. Mechanical fuel level gauge
 - 7. High and low level switches to indicate fuel level
 - 8. Leak detector switch
 - 9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
 - 10. Fill port with overfill prevention valve (OFPV)
 - 11. 5 gallon fill/spill dam or bucket
 - 12. Tank design shall meet the regional requirements for the Project location

2.5 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and

- initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter (3-phase, line to line and line to neutral values).
 2. AC ammeter (3-phases).
 3. AC frequency meter.
 4. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
 5. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
 6. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
 7. DC voltmeter (alternator battery charging).
 8. Engine-coolant temperature gauge.
 9. Engine lubricating-oil pressure gauge.
 10. Running-time meter.
 11. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.
 12. Fuel tank derangement alarm.
 13. Fuel tank high-level shutdown of fuel supply alarm.

14. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR over current, loss of voltage reference, and over excitation shut down protection. There shall be a overload warning, and overcurrent warning alarm.
 15. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
 16. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
 17. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
 18. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
 19. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
- F. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 80 / Class B environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Shunt Excitation
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: SCR type, Separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

- J. Subtransient Reactance: 15 percent maximum, based on the rating of the engine generator set.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Weather Aluminum housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.
- B. Construction:
 - 1. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
 - 2. Exhaust System:
 - a. Muffler Location: Within enclosure.
 - 3. Hardware: All hardware and hinges shall be stainless steel.
 - 4. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
 - 5. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
- C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge.
- D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 10 dBA measured at any location 7 m from the engine generator in a free field environment.
- E. Site Provisions:
 - 1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.8 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Steady-state governing.
 - 6. Single-step load pickup.
 - 7. Simulated safety shutdowns.
 - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
 - B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
 - C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
 - D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.4 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with

critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within pgh of the site.

- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION 263213

TRANSFER SWITCHES
SECTION 263600

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches
 - 2. Bypass/isolation switches
 - 3. Remote annunciation systems
- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
 - 1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
 - 2. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
 - 2. Internal electrical wiring and control drawings.
 - 3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.
 - 4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.

- C. Manufacturer and Supplier Qualification Data
 - 1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
 - 2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.
- E. Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

- A. Only approved bidders shall supply equipment provided under this contract.
- B. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
 - 1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
 - 2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.
 - 3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- C. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.

- E. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 - 1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
 - 2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
 - 3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
 - 4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
 - 5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - 6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
 - 7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
 - 8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
 - 9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
 - 10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
 - 11. IEC 1000-4-6 Conducted Field Immunity
 - 12. IEC 1000-4-11 Voltage Dip Immunity
 - 13. IEEE 62.41, AC Voltage Surge Immunity
 - 14. IEEE 62.45, AC Voltage Surge Testing
- F. Comply with NFPA 99 – Essential Electrical Systems for Healthcare Facilities
- G. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.
- H. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of two (2) year from the warranty start date. The warranty start date is the date of registered commissioning and start up or eighteen (18) months from date of shipment, whichever is sooner.
- I. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify (Architect/Construction Manager/Owner) no fewer than (insert appropriate number) days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without (Architect/Construction Manager/Owner's) written permission.
3. Do not energize any new service or distribution equipment without notification and permission of the (Architect/Construction Manager/Owner).

1.6 COORDINATION

- A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03. See section "INSTALLATION" for additional information on installation
- B. If Project calls for bypass switch(es) mounted on a concrete base, the base must be designed to accommodate the requirements of the drawout mechanism (extension rails and/or wheeled carriage) of the bypass switch.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cummins Power Generation
- B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.
- C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Provide transfer switches in the number and ratings that are shown on the drawings.
- B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.
- C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.
- D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).

- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
 - 2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
 - 3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 - 4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
 - 5. The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function.
 - 6. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
 - 7. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
 - a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
 - 8. Transfer switches designated on the drawings as "4-pole" shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles.
 - 9. Transfer switches designated on the drawings as "isolation-bypass" switches shall meet the requirements of section "BYPASS/ISOLATION SWITCHES" of this specification.
- H. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.
- I. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control

system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism

- J. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- K. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
 - 1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
 - 2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
 - 3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Indicated current ratings:
 - 1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
 - 2. Main contacts shall be rated for 600 VAC minimum.
 - 3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- C. Manual Switch Operation: The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function
- D. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.
- E. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.
- F. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a

common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.

- G. The transfer switch physically located closest to the generator and not more than 50 ft (15 meters) away, except those served by generator paralleling equipment, shall be provided with a battery charger suitable for the requirements of the application and in compliance with NFPA 110 requirements for Level 1 systems. If no transfer switch is located within this distance, a battery charger shall be installed on the generator set.

H. Automatic Transfer Switch Control Features

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
3. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.
4. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
5. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
6. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.
7. The indicator panel LEDs shall display:
 - a. Which source the load is connected to (Source 1 or Source 2)
 - b. Which source or sources are available
 - c. When switch is not set for automatic operation, the control is disabled or the bypass switch is in use
 - d. When the switch is in test/exercise mode
8. The indicator shall have pushbuttons that allow the operator to activate the following functions:
 - a. Activate pre-programmed test sequence

- b. Override programmed delays, and immediately go to the next operation
 - c. Reset the control by clearing any faults
 - d. Test all of the LEDs by lighting them simultaneously
- 9. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
 - a. AC voltage for all phases, normal and emergency
 - b. Source status: connected or not connected.
- 10. The display panel shall be password-protected, and allow the operator to view and make adjustments:
 - a. Set nominal voltage and frequency for the transfer switch
 - b. Adjust voltage and frequency sensor operation setpoints
 - c. Set up time clock functions
 - d. Set up load sequence functions
 - e. Enable or disable control functions including program transition
 - f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history
- I. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. Panel display and indicating lamps shall include permanent labels.
- J. Control Functions: Functions managed by the control shall include:
 - 1. Software adjustable time delays:
 - a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
 - b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
 - c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
 - d. Engine cooldown: 0 to 30 minutes (default 10 min)
 - e. Programmed transition: 0 to 60 seconds (default 3 sec)
 - 2. Undervoltage sensing: three-phase normal, three-phase emergency source.

3. Over-voltage sensing: three-phase normal, three-phase emergency source.
4. Over/under frequency sensing:
 - a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
 - b. Dropout: +/-1% beyond pickup (default 1%)
 - c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
 - d. Accurate to within +/- 0.05 Hz
5. Voltage imbalance sensing:
 - a. Dropout: 2 to 10% (default 4%)
 - b. Pickup: 90% of dropout
 - c. Time delay: 2.0 to 20 seconds (default 5 sec)
6. Phase rotation sensing:
 - a. Time delay: 100 msec
7. Loss of single-phase detection:
 - a. Time delay: 100 msec
- K. Control features shall include:
 1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
 2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
 3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
 4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.
 5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.
- L. Control Interface
 1. Provide one set Form C auxiliary contacts on both sides, operated by transferswitch position, rated 10 amps 250 VAC.

2. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

M. Engine Starting Contacts

1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

2.4 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Description: Transfer switches that are designated on the drawings as "bypass isolation" transfer switches shall be provided with a manually-operated bypass switch arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 1. The bypass switch shall be enclosed in the same cabinet as the automatic transfer switch, and UL-listed as an assembled product.
 2. The bypass isolation switch shall provide a means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load if necessary, and to isolate the transfer switch from both sources for maintenance or repair without a power interruption or disturbance.
 - a. Designs that bypass to only one source are not acceptable under this specification.
 3. The bypass switch shall be operable without the use of tools, and shall include the ability to isolate the automatic switch mechanism without the use of tools and without opening the exterior cabinet door(s).
 4. Operability: Switch shall be constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations, in 15 seconds or less.
 5. Bypass isolation switch equipment shall be UL listed per Standard 1008 and CSA approved, with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch ratings at the specified conditions of ambient temperature, humidity, and altitude.
 6. The bypass isolation and transfer switches shall be mechanically held in each position. Switching mechanisms shall be break-before-make on all poles, including the neutral pole on 4-pole switches except where closed transition transfer is specified as defined in section "CLOSED-TRANSITION TRANSFER SWITCHES". The switch mechanism shall be an over-center toggle device which provides stored energy contact operation during both opening and closing. The speed of contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load.
 7. Provide means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks shall prevent transfer-switch operation, except for testing or maintenance.

8. Bypass switch shall be a fully-rated, manually-operated switch, rated for the same loads as the automatic transfer switch. Bypass switch shall provide bypass to either normal or emergency source by use of a door mounted, keyed source selector switch and a permanently mounted external operating handle. Equipment shall provide manual bypass without disturbance of the power supply to the load.
 - a. Equipment requiring load isolation before bypass is not acceptable for use on this Project.
9. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
10. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
11. Positive mechanical interlocks shall prevent all possible source-to-source interconnections via the bypass switch. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.
 - a. Designs which depend on electrical interlocks to prevent source to source interconnections, or which intentionally interconnect the sources via the bypass switch, are not acceptable.
12. The equipment shall utilize automatic, mechanical stops to prevent manually bypassing to a dead source.
 - a. Equipment that does not prevent dead source bypass is not acceptable.
13. A drawout isolation mechanism shall provide closed-door isolation of the transfer switch. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open before the mechanism will permit isolation of the transfer switch. Drawout arrangement must provide physical separation from live parts and accessibility for testing and maintenance operations.
14. The isolation mechanism shall provide for three-position operation: Connected, Test, and Isolated. In the Connected position, isolation contacts shall be fully engaged and closed, with the transfer switch control cable connected. In the Test position, isolation contacts shall be open and the transfer switch control cable connected. The Test position shall allow operational testing of transfer switches and controls without power disruption to the load. In the Isolated position, the transfer switch and control shall be completely isolated from all power sources. In the Isolated position, the transfer switch shall be capable of being withdrawn from the cabinet.
15. The bypass and isolation process for the automatic transfer switch shall be capable of being fully accomplished without opening the cabinet door.
16. Interconnection of bypass/isolation switch with automatic transfer switch shall consist of factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.

17. Note the size and access requirements for the transfer switch with bypass isolation and provide equipment that will fit into the space allowed as well as complying with code-specified access requirements.
 18. Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.

2.5 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Switch position.
 3. Switch in test mode.
 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 3. Switch in test mode.
 4. Lamp Test: Push-to-test or lamp-test switch on front panel.
- C. Malfunction of annunciator or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.
- D. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:
 - a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 SOURCE QUALITY CONTROL

- A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.

- B. Manufacturer's representative shall perform tests and inspections and prepare test reports.
- C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
 - 1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
 - 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify that the transfer switch is accurately metering AC voltage.
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 DEMONSTRATION

- A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
 - 1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
 - 2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

3.6 SERVICE AND SUPPORT

- A. The manufacturer shall supply the Service Provider with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:
1. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.
 2. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical "strip chart" displays.
 3. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.
 4. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

END OF SECTION 263600

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Highbay, linear.
4. Highbay, nonlinear.
5. Linear industrial.
6. Lowbay.
7. Parking garage.
8. Recessed, linear.
9. Strip light.
10. Surface mount, linear.
11. Surface mount, nonlinear.
12. Suspended, linear.
13. Suspended, nonlinear.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Fixtures as specified, or equal to the specified. No additional monies to be awarded to the contractor to make fixture equal, as reviewed by Engineer.
 2. Arrange in order of luminaire designation.
 3. Include data on features, accessories, and finishes.

4. Include physical description and dimensions of luminaires.
 5. Include emergency lighting units, including batteries and chargers.
 6. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 7. Photometric data and adjustment factors based on laboratory tests complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.
- E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule: For luminaires and lamps.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Structural members to which equipment and or luminaires will be attached.
 5. Initial access modules for acoustical tile, including size and locations.
 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.

- d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
- 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of luminaire.
- E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

2.3 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 - 1. 1. Manufacturer's standard grade.
 - 2. 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

- E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

**LED EXTERIOR LIGHTING
SECTION 265619**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.
 - 3. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Fixtures as specified, or equal to the specified. No additional monies to be awarded to the contractor to make fixture equal, as reviewed by Engineer.
 - 2. Arrange in order of luminaire designation.
 - 3. Include data on features, accessories, and finishes.
 - 4. Include physical description and dimensions of luminaire.
 - 5. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-80.

- a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
7. Wiring diagrams for power, control, and signal wiring.
 8. Photoelectric relays.
 9. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- D. Product Schedule: For luminaires and lamps.
- E. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Structural members to which equipment and luminaires will be attached.
 3. Underground utilities and structures.
 4. Existing underground utilities and structures.
 5. Above-grade utilities and structures.
 6. Existing above-grade utilities and structures.
 7. Building features.
 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
1. Luminaire.
 2. Photoelectric relay.
- E. Source quality-control reports.
- F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.

- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 80. CCT of 3500 K
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: See Fixture Schedule On Drawings
- L. In-line Fusing: Separate in-line fuse for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- N. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum, Stainless steel, or Epoxy-coated steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.4 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: By Architect
- D. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by Architect from manufacturer's full range.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Coordinate layout and installation of luminaires with other construction.
- H. Adjust luminaires that require field adjustment or aiming.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 BOLLARD LUMINAIRE INSTALLATION:

- A. Align units for optimum directional alignment of light distribution.
 - 1. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.

- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.9 DEMONSTRATION

- A. **Train Owner's** maintenance personnel to adjust, operate, and maintain luminaires.

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

**FIRE ALARM SYSTEM
SECTION 283111**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, and auxiliary fire alarm equipment and power and signal wire and cable.
- B. Related Sections:
 - 1. Section 260519 - Building Wire and Cable.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 72 - National Fire Alarm Code.
 - 2. BOCA Building Code.
 - 3. National Electric Code.

1.3 SYSTEM DESCRIPTION

- A. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to an approved monitoring station.
- B. Provide a complete Fire Alarm System as described herein and as shown on the plans; to be wired, connected, and left in an operating condition. The system shall use analog addressable initiating device circuits with individual device supervision, individual notification appliance circuit supervision, incoming, and standby power supervision. Include control panels, power supplies, remote annunciators, manual pull stations, addressable interfaces to sprinkler system devices furnished by others (if applicable), and kitchen suppression systems furnished by others (if applicable), Speakers, horns, strobes, remote control devices, wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.
- C. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate expansion, building parameter changes or changes as required by local codes. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- D. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. The catalog numbers specified under this section are those of Simplex constitute the material and desired operating features to be furnished.

1.4 OPERATION

- A. Under normal condition, the front panel shall display a "SYSTEM NORMAL" message

and the current time and date.

- B. Should an abnormal condition be detected, the appropriate LED ("Fire Alarm", "System Supervisory", or "System Trouble") shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
- C. The panel shall have an eighty (80) character LCD display. The following information relative to the abnormal condition of a point in the system shall be displayed:
 - 1. Custom location label describing the exact location of the device to include floor, room number (or nearest room number for corridor mounted devices). No two devices shall have the same location label. Provide forty (40) characters minimum to describe location information, this is in addition to the "type of device" and "status" requirements listed below.
 - A. The custom location label of each device shall be capable of being edited by the owner from the front panel controls. An off board programmer and or/computer shall not be required for the owner to change this information.
 - 2. Types of device (i.e. smoke, pull station, waterflow). Provide twenty (20) characters minimum to describe device type information.
 - 3. Point status (i.e. alarm, trouble, sprinkler supervisory). Provide twenty (20) characters minimum to describe point status.
- D. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition. (The acknowledge, reset and bypass functions shall be pass-code protected. Three levels of pass-code protection shall be provided). If the user has insufficient privilege to acknowledge such conditions, a message shall indicate insufficient privilege but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message will be displayed informing the user that the condition has been acknowledged.
- E. Alarm Silencing
 - 1. Should the "Alarm Silence" button be pressed, all audible notification appliances shall be deactivated. Visual indicating appliances shall continue to flash until the system is reset.
 - A. A dedicated "Alarm Silenced" LED indicator located on the front panel display shall be illuminated.
 - B. Should another alarm be reported, the audible notification appliances shall re-sound and the "Alarm Silenced" LED shall be extinguished until deactivated by the "Alarm Silence" button as described above.
- F. System Reset
 - 1. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process with simple English language messages. Messages shall provide operator assurance of the sequential steps (i.e.: "IN PROGRESS", "RESET COMPLETED", and "SYSTEM NORMAL") as they occur, should all alarm conditions be cleared.

2. Should an alarm condition continue to exist, the system will remain in an abnormal state. System control relays shall not reset. The panel audible signal and the Alarm LED shall be on. The display will indicate the total number of alarms and troubles present in the system along with a prompting to review the points. These points will not require acknowledgment if they were previously acknowledged.

G. History Logging

1. In order to recreate a sequence of events in a fire or trouble investigation, the control panel shall store system abnormal conditions in three separate logs. Alarm activities shall be stored in an "Alarm Log", sprinkler supervisory (tamper switch) activation in a "Supervisory Log", and trouble events in a "Trouble Log". The time and date of each occurrence must be included with each entry. These events shall be stored in a battery protected random access memory (RAM). In order to prevent re-occurring trouble and/or sprinkler supervisory conditions from overwriting other information, it is mandatory that each type of event be stored separately. Systems that are not equipped with separate logs, as described, shall include a UL listed fire alarm printer with battery back-up to record system activity including time and date of each occurrence.

H. Walk Test with History Logging

1. The system shall be capable of being tested by one person. While in testing mode, the alarm activation of an initiating device shall cause the system audible indicating devices to sound in a coded pattern that uniquely identifies the initiating device that is activated. The panel shall then automatically reset itself after logging of the alarm.
2. The momentary disconnection of an initiating device, notification appliance, or the grounded condition of any circuit shall cause the system audible indicating appliances to sound for four (4) seconds. The panel shall automatically reset itself after logging of the trouble condition.
3. Should the walk test feature of the system be activated for eight (8) hours without testing activity, the system shall revert to the normal mode of operation automatically.

I. System Trouble Reminder

1. Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at eight (8) hour time intervals to act as a reminder to the owner that the fire alarm system is not 100% operational.

J. Smoke Sensor Operation

1. The smoke sensors shall automatically meet NFPA sensitivity testing requirements.
 - A. The control panel shall be listed as a calibrated sensitivity testing instrument that will automatically meet NFPA 72E Sensitivity Testing Requirements. The requirement to test the sensitivity of each detector within one year of installation and every alternate year thereafter as described in NFPA 72E shall not need to be performed manually.

2. The smoke sensors shall be smoke density measuring devices having no self contained alarm set-point. The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to stored values.
 3. The control panel shall maintain a moving average of the sensors smoke chamber value. The system shall automatically maintain a constant smoke obscuration sensitivity for each sensor and compensate for environmental factors such as dust accumulation.
 4. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value, a "Dirty Sensor" trouble condition shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visual indication at the sensor location.
 - A. The smoke sensor shall not be operating at an increased sensitivity level due to the dust/dirt contamination. It shall continue to operate at the pre-set sensitivity level.
 - B. Maintenance personnel shall be able to get a report of sensors that are "Almost Dirty" from the control panel display so that these sensors can be serviced while maintenance on the dirty sensors is being performed.
 5. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function shall allow a "pre-alarm" indication to occur when, for example, a 3% sensor reaches a threshold of 1.5% smoke obscuration.
 6. The control panel shall log the peak smoke obscuration level (for smoke sensors) or temperature (for heat sensors) at each device location. This shall enable an operator to set the sensitivity of individual sensors slightly above the normal environmental conditions in order to optimize the performance and reduce nuisance alarms within the system.
 7. The device addressing mechanism shall permit the user to replace faulty sensors with spare units without the need for an electronic programming machine.
- K. Notification Appliance Operation
1. The system shall provide for the synchronization and control of the audible and visible notification appliances on a common 2-wire circuit. Visual and audible signals shall be synchronized across all notification appliance circuits in the system. The audible notification signal shall be in a temporal code pattern as described by NFPA 72 and shall remain active until the "Alarm Silence" switch is activated at the fire alarm control panel (or at the remote annunciator panel). The visible notification appliances (xenon strobes) shall be synchronized and shall remain active until the system is reset.

1.5 ALARM SEQUENCE

- A. The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device is to be as follows:
 1. All audible alarm notification appliances shall sound a temporal code pattern (.5 sec. on, .5 sec. off, .5 sec. on, .5 sec. off, .5 sec. on, 2.5 sec. off, then repeat) until silenced by the alarm silence switch at the control panel or at the remote

annunciator panel.

2. All visible alarm notification appliances, Xenon Strobes, shall display a continuous pattern until the system is reset.
 3. All doors normally held open by door control devices shall release.
 4. The alarm signal shall be reported an off site monitoring facility. The digital communicator furnished with this project shall be programmed to report to the owners selected monitoring company.
 5. The alarm is to be recorded with the time and date in the system's alarm log.
- B. The alarm activation of any elevator lobby smoke detector shall, in addition to the operations listed above, cause the elevator cabs to be recalled according to the following sequence:
1. If the alarmed detector is on any floor other than the main level of egress, the elevator cabs shall be recalled to the main level of egress.
 2. If the alarmed detector is on the main egress level, the elevator cabs shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.

1.6 SUPERVISION

- A. The disarrangement condition of any circuit shall not disrupt the operation of any other circuit.
- B. Each addressable initiating device and independently supervised circuit shall include a discrete panel readout to indicate disarrangement conditions.
- C. The incoming power to the system shall be supervised so that any power failure must be audibly and visibly indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
- D. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visibly indicated at the control panel and remote annunciator.
- E. The system shall provide for an operator to disable and enable each addressable device, indicating appliance circuit and each relay control circuit individually for maintenance or testing purposes.
- F. If any addressable device is removed a "Device Missing" message along with the exact location of the missing device must be indicated at the fire alarm control panel and at the remote annunciator panel along with a system trouble indication.
- G. If more than one addressable initiating device is inadvertently programmed with the same address, a "Duplicate Address" error shall be displayed on the control panel operator's display.

1.7 POWER REQUIREMENTS

- A. The control panel shall receive 120 VAC power (as noted on the plans) via a dedicated circuit.

- B. The control panel shall contain four Notification Appliance Circuits for alarm Speakers and strobes as a minimum. Notification Appliance Circuit Extender Panels shall be furnished and installed as required to operate all notification appliances shown on the plans, or as required to meet the device power requirements, with 35% spare capacity per circuit for future additions.
- C. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of sixty (60) hours with five (5) minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Batteries shall be sized to meet the requirements stated above with a 50% spare capacity for future additions.
- D. All circuits requiring system operating power shall be 24VDC and shall be individually fused at the control panel.

1.8 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures. Include bound data books.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations (i.e., voltage drop not to exceed 5%). A detailed battery calculation document indicating each control panel component and peripheral device along with the following information:
 - 1. The quantity of each component
 - 2. The stand-by and alarm power requirements of each component
 - 3. Calculations to clearly indicate battery size needed to comply with the specification requirements.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements.
- D. Where more than one product model is described on the manufacturer's data sheet, the specific unit proposed shall be highlighted or otherwise identified.
- E. Test Reports: Indicate procedures and results for specified field testing and inspection.
- F. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.9 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of fire alarm equipment.
- C. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of project.
- B. Installer: Certified fire alarm installer with service facilities within 50 miles of Project.
- C. Design fire alarm under direct supervision of NICET certified designer experienced in design of this Work.

1.11 MAINTENANCE SERVICE

- A. Division 1 - Execution Requirements: Maintenance service.
- B. Furnish service and maintenance of fire alarm equipment for one year from Date of Substantial Completion.

1.12 MAINTENANCE MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.

1.13 WARRANTY

- A. Furnish one year manufacturer warranty for air handling units.

1.14 EXTRA MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.
- B. Furnish two of each type of automatic smoke detector with base.

PART 2 PRODUCTS**2.1 CONTROL PANEL**

- A. Manufacturers:
 - 1. Simplex Model 4100 Fire Alarm Control Panel, Remote Power Supplies and network card compatible with existing Simplex fire alarm network.
 - 2. Pyrotronics MXL-IQ
 - 3. Substitutions: Not Permitted.
- B. The Control Panel shall have an 80-character LCD display and perform all functions listed in this specification. The display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there should be keypad activity.
- C. The Control Panel shall contain all necessary hardware and software required to monitor a minimum of 250 addressable devices and monitor and control four (4) notification appliance circuits. It shall contain a minimum of two (2) programmable auxiliary relays and contain the circuitry to operate a serial controlled remote annunciator panel.
- D. The control panel shall be capable of operating on a "peer-to-peer network" with similar control panels to enable individual system expansion and the capability to monitor,

control and program systems in different facilities from one central location.

- E. Provide network adapter card for connection to existing Simplex fire alarm network.
- F. Provide cabinets of sufficient size to accommodate the aforementioned equipment. The cabinets shall be equipped with locks and transparent door panels providing freedom from tampering yet allowing full view of the various lights and controls.

2.2 NAC POWER EXTENDER PANELS

- A. Furnish and install Notification Appliance Circuit Extender Panels as required to operate the alarm notification appliances shown on the plans. Allow for 50% spare capacity per circuit. Each power extender panel shall provide four (4) supervised notification appliance circuits and an 8 Amp power supply. The panel shall digitally communicate with the fire alarm control panel to provide for the synchronization and control of the audible and visible notification appliances on common 2-wire circuits. All visual and audible signals shall be synchronized across all notification appliance circuits in the system. The audible notification signals (Speakers) shall sound in a temporal code pattern as described by NFPA 72 and shall remain active until the "Alarm Silence" switch is activated at the fire alarm control panel (or at the remote annunciator panel). The visible notification appliances (xenon strobes) shall remain active until the system is reset. The four circuits shall be individually software controlled from the fire alarm control panel. The panel shall monitor each of its' output circuits for trouble conditions and report back to the fire alarm control panel, by circuit, if a trouble occurs. Each panel shall be equipped with stand-by batteries sized to provide sixty (60) hours of standby followed by five (5) minutes of alarm operation.

2.2 MANUAL FIRE ALARM STATIONS

- A. Manufacturers:
 - 1. By fire alarm panel manufacturer.
 - 2. Substitutions: Not Permitted.
- B. Product Description: Manual single-action addressable station.
- C. Mounting: Semi-Flush (surface where required because of construction).
- D. Type: Addressable.
- E. Backbox: Manufacturer's standard.

2.3 CONVENTIONAL ZONE INTERFACE

- A. Manufacturers:
 - 1. Addressable by fire alarm panel manufacturer.
 - 2. Substitutions: Not Permitted.
- B. Product Description: MAPNET II Addressable conventional zone interface module to provide addressability to conventional circuits and to supervise and operate 24 VDC notification appliances.

2.4 CONVENTIONAL ZONE INTERFACE

- A. Manufacturers:
 - 1. IAM Addressable by fire alarm panel manufacturer.
 - 2. Substitutions: Not Permitted.

- B. The units shall provide location specific addressability to non-addressable devices such as waterflow, sprinkler tamper switches, and kitchen suppression systems, furnished by others, by monitoring normally open dry contacts. Closure of the monitored contact shall initiate an alarm or supervisory condition, as required. An open in the initiating circuit will cause a trouble to be reported at the fire alarm control panel. Units shall mount in a standard single gang electrical box.

2.5 SPOT HEAT DETECTOR

- A. Manufacturers:
1. Addressable by fire alarm panel manufacturer.
 2. Substitutions: Not Permitted
- B. Product Description: NFPA 72 ceiling heat detector with the following features:
1. Combination rate-of-rise and rate compensated fixed temperature sensor of which both operations are self-restoring.
 2. The sensor's small thermal mass shall allow an accurate up-to-date temperature reading of each sensor to be logged at the control panel. The rate of rise operation shall be selectable in either a 15-degree per minute or a 20-degree per minute rate of temperature rise. The fixed temperature principle shall operate entirely independent of the rate of rise principle and shall be selectable for either 135 degrees or 155 degrees Fahrenheit.
 3. The heat detectors shall be UL listed to standard 521 for sixty (60) foot spacing at the 135 degree setting and forty (40) foot spacing at the 155 degree setting.

Note: Heat sensors located in Data Closets shall be programmed as utility devices to monitor for temperature extremes in these areas. If any of these sensors detect temperatures exceeding 95 degrees Fahrenheit, a separate signal shall be transmitted to the Campus Police Office to alert of possible HVAC system problems that could affect data system operation. The fire alarm sequence shall not be initiated

C. Temperature Rating: 135 degrees F.

D. Rate-of-Rise: 15 degrees F.

2.6 CEILING SMOKE DETECTOR

- A. Manufacturers:
1. Addressable by fire alarm panel manufacturer.
 2. Substitutions: Not Permitted.
- B. Product Description: NFPA 72 photoelectric type ceiling smoke detector with the following features:
1. Sensors shall be of the photoelectric type and shall communicate actual smoke chamber values to the system control panel.
 2. The sensors shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which they are connected.
 3. The sensors shall be listed for both ceiling and wall mount applications.
 4. The sensitivity of each individual detector shall be programmable from the control panel.
 5. The sensors shall automatically compensate for the accumulation of dust and dirt to maintain operation at their programmed sensitivity level as these contaminants accumulate. The control panel shall identify the need for individual sensors to be cleaned before the contamination effects their sensitivity. In order to assist maintenance personnel, the control panel shall report sensors that are "almost dirty" so that these units can be serviced at the same time as sensors reporting a

"dirty" condition. The sensors shall be documented to automatically meet NFPA sensitivity testing requirements.

6. Smoke sensors shall mount to a Simplex #4098-9794 sounder base for all rooms.

C. Mounting: Manufacturer's standard outlet box.

2.7 DUCT-MOUNTED SMOKE DETECTOR

A. Manufacturers:

1. Addressable by fire alarm panel manufacturer.
2. Substitutions: Not Permitted.

B. Product Description: NFPA 72 photoelectric type with the following features:

1. The sensors shall meet the requirements of UL Standard 268A and shall be documented compatible with the control equipment to which they are connected.
2. The addressable duct smoke sensors shall operate on the light-scattering, photodiode principal, and shall communicate actual smoke chamber values to the system control. The sensors shall not have a self contained smoke sensitivity setting and shall automatically compensate for environmental changes. The sensor's electronics shall be completely shielded to protect against false alarms from EMI and RFI.
3. The duct housing shall contain a transparent cover with a visible red and yellow LED which shall indicate normal, alarm, and trouble conditions including supervision of the remote relays.
4. The Duct housing supervised output to drive a remotely mounted 4098-9843 SPDT auxiliary relay rated at 10 amps @ 120VAC or 7 amps @ 28VDC for unit shutdown. This relay output must be programmable from the fire alarm control panel to operate independently of detector activation to provide total unit shutdown and bypass control from the fire alarm control panel. Up to 15 of these relays can operate on this supervised duct detector output. Relays will mount in a 4 inch square box with cover.
5. The duct detectors shall obtain 24VDC operating power from the fire alarm control panel.
6. The duct detectors shall utilize cross sectional sampling principle by which a sampling tube is extended across the duct to continuously sample the air movement through the duct, after which the sampled air is returned to the duct via an exhaust tube. Sampling tubes shall be properly sized for the duct in which they are installed. The duct housing shall include a magnetic test area and test ports to allow magnetic and aerosol testing without removal of the housing cover.
7. Provide a Simplex type 2098-9806 Remote Alarm Indicator, located next to FACP, with Test Keyswitch for each duct smoke sensor installed.
8. Duct sampling tubes shall extend width of duct.

2.8 STROBES

A. Manufacturers:

1. Johnson Systems
2. Substitutions: Not Permitted.

B. Product Description: NFPA 72 Audible Only and Audible/Visible with the following features:

1. The appliances shall provide minimum 75 cd illumination and have a flash rate of 1 Hz over the entire operating voltage range as required by the Americans with Disabilities Act (ADA). Provide 110 cd where shown.
2. The notification appliances shall be UL listed to Standard 1971.

3. The specified control panel shall provide for the synchronization and control of the system audible and visible notification appliances on a common 2-wire circuit.
4. The visible notification signals (xenon strobes) shall be synchronized and shall remain active until the system is reset. The units shall be labeled with the word "FIRE" in a contrasting color and the height of each character shall be a minimum of 5/8". In its' quiescent state, the word "FIRE" shall be visible. The devices shall semi-flush mount directly to standard single gang, double gang, and 4" square electrical boxes without the use of special adapters or trim rings.

2.9 SPEAKER/STROBE

- A. Manufacturers:
 1. Johnson Systems
 2. Substitutions: Not Permitted.
- B. Product Description: NFPA 72 strobe lamp and flasher with red lettered "FIRE" on white housing.
- C. Product Description: NFPA 72 Speaker/Visible with the following features:
 1. Polycarbonate lens.
 2. The visible portion of the appliances shall provide a minimum 75 cd illumination and have a flash rate of 1 Hz over the entire operating voltage range as required by the Americans with Disabilities Act (ADA). Provide 110 cd where shown.
 3. The output of the audible portion of the appliance shall be rated at minimum of 85dBA at 10 feet. The notification appliances shall be UL listed to Standards 1971 and 464. The specified control panel shall provide for the synchronization and control of the audible and visible portions of these devices on a common 2-wire circuit.
 4. All visible notification signals (xenon strobes) shall be synchronized and shall remain active until the system is reset.
 5. The units shall be labeled with the word "FIRE" in a contrasting color and the height of each character shall be a minimum of 5/8". In its' quiescent state, the word "FIRE" shall be visible.
 6. The devices shall semi-flush mount directly to standard single gang, double gang, and 4" square electrical boxes without the use of special adapters or trim rings.

2.10 WATERFLOW AND OS&Y MONITOR SWITCHES

- A. Waterflow and OS&Y Monitor Switches shall be furnished and installed under other sections of these specifications but shall be wired and connected to the Fire Alarm System by the Electrical Contractor.

2.11 DOOR RELEASE

- A. Manufacturers:
 1. By fire alarm panel manufacturer.
 2. Substitutions: Not Permitted.
- B. Product Description: Magnetic door holder with integral diodes to reduce buzzing.
- C. Coil voltage: 24 VDC.

2.12 WIRE AND CABLE

- A. Manufacturers:
 - 1. Fire alarm manufacturer's required cable, Cu conductors. Addressable circuits shall use minimum twisted, shielded pair #18AWG Cu wire and shall allow for T-tapping of the circuit (all wiring on addressable circuits shall be approved by the system manufacturer). Use minimum #14AWG Cu conductors for indicating circuits, and #12AWG-Cu for power circuits.
 - 2. Substitutions: Not Permitted.
- B. Product Description: Non-power limited fire-protective signaling cable, copper conductor, THHN insulation rated 90 degrees C. Power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degrees C.
- C. Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Mark each terminal according to the wiring diagrams of the system. Make all connections with the manufacturer's approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Plenum Cable: Power limited fire-protective signaling cable classified for fire and smoke characteristics, copper conductor, 300 volts insulation rated 105 degrees C, suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.
- E. Wiring to Central Station Transmitter: 1-inch (Size 27) conduit between the FACP and the central station transmitter connection as indicated. Install number of conductors and electrical supervision for connecting wiring as required to suit central-station monitoring function.
- F. Fire alarm circuit conductors have insulation color or code as follows:
 - 1. Power Branch Circuit Conductors: Black, red, white.
 - 2. Initiating Device Circuit: Black, red.
 - 3. Detector Power Supply: Violet, brown.
 - 4. Signal Device Circuit: Blue (positive), white negative.
 - 5. Door Release: Gray.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify products and systems receiving devices are ready for installation.

3.2 INSTALLATION

- A. Install 14 AWG minimum size conductors for fire alarm detection and signal circuit conductors in red MC conduit.
- B. Install signal wire in red MC conduit.
- C. Connect system to elevator recall and, if required, elevator power shutdown.
- D. Mount end-of-line device in control panel or box with last device or separate box adjacent

- to last device in circuit.
- E. Mount outlet box for electric door holder to withstand **80 pounds** pulling force.
- F. Connect conduit and wire to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control panels and duct smoke detectors. Provide all required addressable modules.
- G. Automatic Detector Installation: Conform to NFPA 72.
- H. Install engraved plastic nameplates in accordance with Division 16.
- I. Ground and bond fire alarm equipment and circuits in accordance with Division 16.
- J. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles 44 inches above finished floor or as indicated.
- K. Smoke Detectors: Install ceiling-mounted detectors in center of corridors or as indicated on the drawings but not less than 4 inches (100 mm) from a side wall to the near edge. Install detectors located on the wall at least 4 inches (100 mm) but not more than 12 inches (300 mm) below the ceiling. For exposed solid joist construction, mount detectors on the bottoms of the joists. On smooth ceilings, install detectors not over 30 feet (9 m) apart in any direction. Install detectors no closer than 5 feet (1500 mm) from air registers.
- L. Audible Alarm-Indicating Devices: Install not less than 80 inches above the finished floor nor less than 6 inches (160 mm) below the ceiling. Install bells and speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.
- M. Visual Alarm-Indicating Devices: Install at 80 inches (2000 mm) above the finished floor or 6 inches (150 mm) below the ceiling, whichever is lower.
- N. Remote Alarm Indicators/Test Switches: Locate in the public space immediately adjacent to the device they monitor.
- O. Fire Alarm Control Panel (FACP): Surface mount with tops of cabinets not more than 6 feet (1800 mm) above the finished floor.
- P. Remote Annunciator: Arrange as indicated, with the top of the panel no more than 6 feet (1800 mm) above the finished floor.

3.3 FIELD QUALITY CONTROL

- A. Division 1 - Quality Requirements: Testing and inspection services 01700 - Execution Requirements: Testing, adjusting, and balancing.
- B. Test in accordance with NFPA 72 and local fire department requirements. Provide certificate that system was tested.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Division 1 - Quality Requirements: Manufacturer's field services.
- B. Include services of factory trained technician to supervise installation, adjustments, final connections, and system testing.

3.5 DEMONSTRATION AND TRAINING

- A. Furnish 16 hours of instruction each for maintenance personnel to be conducted at project site with manufacturer's representative.

3.6 WARRANTY

- A. Provide one years manufacturer's warrentee on all parts and workmanship.

END OF SECTION 283111

**EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM
SECTION 283150**

1.1 EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM (BDA SYSTEM)

A. General

1. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local fire department and other agencies and authorities having jurisdiction. System users shall receive and transmit radio broadcasts from their portable radio units within the building. This shall be accomplished utilizing the following components:
 - a. Bi Directional Amplifiers (Signal Boosters)
 - b. Plenum rated Coaxial Cable
 - c. Antennas
 - d. Cable taps
 - e. Connectors
 - f. Power dividers
 - g. Other components and interconnecting circuitry as required
2. The system shall comply with the requirements of UL2524 1st Edition (pending) In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72 2010 Edition, NFPA 1221 2016 Edition and IFC 2018, as referenced.
3. The entire system shall meet with approval of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
4. The work in this section shall include the responsibility for all filings with the AHJ. Where filings require engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.
5. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner
6. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included as the part of the required work.
7. The in-building emergency radio communication enhancement system shall use a UL2524 1st Edition (pending), NFPA-72 2010 Edition, NFPA 1221 2016 Edition and IFC 2018 compliant Honeywell signal booster or approved equal.

B. Design requirements

1. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.
2. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.
3. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.
4. The In-building emergency radio communication enhancement systems must provide the following signal strengths:
 - a. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
 - b. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.
5. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.
6. EC shall sub-contract an approved manufacturer or a qualified and approved vendor to supply, test and determine locations of components which are required for proper operation as well as to supply, deploy, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.
7. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.
8. The system design shall be based on the Honeywell line of Public Safety Signal Boosters UL2524 1st Edition (pending), NFPA-72 2010 Edition, NFPA 1221 2016 Edition, IFC 2018 Edition and FCC compliant to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waive any requirement or performance of individual components described in the specifications.
9. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.
10. Survivability from attack by fire shall meet NFPA 72, National Fire Alarm and Signaling Code, 2010 edition and NFPA 1221 2016 edition.

11. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.
12. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions

C. Technical Specifications and Performance Requirements

1. The system specified shall be based upon Honeywell line of Public Safety UL2524 1st Edition (pending), NFPA-72 2010 Edition, NFPA 1221 2016 Edition, IFC 2018 Edition compliant signal boosters
2. The signal booster shall be a Class B Public Safety type as designated by the FCC and as required by the AHJ.
3. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA-72, 2010 edition and NFPA 1221,2016 edition. The signal booster shall have both the primary and the secondary power supplies built in a fully sealed NEMA-4 type approved enclosure.
4. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.
5. The signal booster shall be set and tuned by the equipment manufacturer to pass frequencies as specified by the local fire department.
6. To reduce the possibility of unwanted interference affecting the operation of the system, signal boosters shall be band or channel selective type with a maximum 3dB channel bandwidth of 200KHz (Fc +/- 100KHz). Wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.
7. Signal Boosters shall have oscillation prevention circuitry to protect the public safety radio system in case of signal booster malfunction.
8. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 25dB range. System gain shall be set and documented at the time of the final system test.
9. Maximum Propagation delay of the signal booster system shall be 14μs (microseconds) or as specified by AHJ.
10. The signal booster system shall include built-in automatic alarming of malfunctions of the signal booster and battery system as per NFPA 1221 2016 Edition Section 9.6, NFPA 72, 2010 Edition, Sections 24.5.2.6.1, and 24.5.2.6.2. Aftermarket equipment add-ons and modifications to comply with this specification will not be accepted.
11. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all

signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

- a. Normal AC power
 - b. Signal booster trouble
 - c. Antenna Failure
 - d. Loss of normal AC power
 - e. Failure of battery charger
 - f. Low battery capacity
12. The signal booster system shall include six alarm relay outputs with line termination for Fire Alarm Panel connection for monitoring the signal booster.
 13. The vendor shall verify the system monitoring requirements with the AHJ prior to system installation. System monitoring shall be fully compliant with the AHJ requirements.
 14. External filters, attachments or other aftermarket modifications of the original equipment shall not be accepted.
 15. All signal booster components shall be contained in a NEMA4-type approved waterproof cabinet. All enclosures shall be painted red with signage in bright yellow or as required by AHJ

D. Installation Requirements

1. Assembly and installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code, NFPA-70 and the National Fire Alarm and Signaling Code, NFPA-72, NFPA 1221 current enforceable editions.
2. At least 2 independent and reliable power supplies shall be provided as specified in sections 2 and 3 below.
3. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, NFPA 72, National Fire Alarm and Signaling Code, 2010 edition and NFPA 1221 2016 edition.
4. The emergency responder radio coverage enhancement system shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a non-vented NEMA4 Type approved enclosure. Batteries shall be enclosed in a separate, vented NEMA 3R Type approved enclosure.

5. The signal booster shall be designed to allow degraded performance in adverse conditions, such as high temperatures in the event of heat from a nearby fire, voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) are not acceptable. External UPS (Uninterruptable Power Supplies) are not acceptable. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster, even to the extent of damaging the signal booster, as long as some communications benefit can be provided during the emergency.
6. System design shall be such that neither the failure of the normal power source, the transfer to an emergency source, nor the re-transfer to the normal source shall cause a change in system status.
7. The amplifier shall be housed in a 2-hour fire rated room or other suitable space as approved by the Engineer, or where specifically shown on the drawing.
8. Radiating cable, if used, shall be run without conduit. All other cable can be run in conduit if required for mechanical protection of the cable, or where specified by the electrical engineer.
9. RF Coaxial Cable shall be a fire-resistant, low-smoke type, U.L. classified as plenum. The classification shall be clearly marked on the outer surface of the cable regular intervals.

E. Acceptance and Test Procedures

1. Acceptance testing for an in-building radio system is required upon completion of installation.
2. The coverage testing shall be done in accordance with NFPA 72, National Fire Alarm and Signaling Code, 2010 edition, NFPA 1221 2016 edition and as required by the local AHJ
3. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.
4. All test records along with system diagrams, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project.

END OF SECTION 283150

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
1. Subsoil materials.
 2. Topsoil materials.
- B. Related Sections:
1. Section 31 05 16 – Aggregates for Earthwork.
 2. Section 31 22 13 – Rough Grading.
 3. Section 31 23 16.13 – Trenching.
 4. Section 31 23 23 – Fill.
 5. Section 31 25 00 – Erosion Controls.
 6. Section 32 91 19 – Landscape Grading.
 7. Section 32 92 19 – Seeding.
 8. Section 32 93 00 – Plants.

1.3 UNIT PRICES - MEASUREMENT AND PAYMENT- NOT USED

1.4 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- C. PennDOT Publication 408, current edition.
- D. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.
- E. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 SUBMITTALS

- A. Materials Source: Submit name of imported materials source and provide a "clean fill" certification. No material shall be brought on-site of unknown origin.
- B. Manufacturer's Certificate: Certify Structural Fill meets or exceeds gradation envelope.
- C. Compost Mix: If pre-mixed amended soil is used, submittals stating the mix ratio must be provided. Submit testing report to certify compost meets PA DEP standards as shown on the drawings.

1.6 QUALITY ASSURANCE

- A. Furnish each subsoil and topsoil material from single source throughout the Work.
- B. Perform Work in accordance with PennDOT Publication 408, current edition.
- C. Perform Work in accordance with the PA DEP BMP Manual, current edition.

PART 2 - PRODUCTS

2.1 SUBSOIL MATERIALS

- A. General Fill shall conform with PennDOT Publication 408, Section 206 – Embankment.
- B. General Fill Material shall be of a maximum size that can readily be placed in loose 8 - inch lifts when using relatively heavy compaction equipment or in 4-inch thick or smaller loose lifts when using relatively light compaction equipment.
 - 1. Gradation and Classification – Per Geotechnical Report.
 - 2. Minimum dry mass density – 95 percent of the laboratory determined maximum dry density as determined by ASTM D1557 (Modified Proctor).

2.2 STRUCTURAL FILL MATERIALS

- A. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand with at least 90 percent passing a 1-1/2-inch sieve and not more than 20 percent passing a No. 200 sieve and with a plasticity index not greater than 8 percent. Recycled concrete is considered suitable for use as engineered fill even though the percent passing the No. 200 sieve may be greater than 20 percent. Imported fill material shall be approved by Owner's Representative well in advance of fill construction.
- B. Structural fill shall be compacted to at least 95 percent of the laboratory determined maximum dry density as determined by ASTM D1557 (Modified Proctor) methods for subgrade and/or beneath foundations and/or structural elements and 90 percent of the laboratory determined maximum dry density for subgrade not beneath structural elements or behind foundations.
- C. Structural fill materials shall comply with the recommendations of the geotechnical report.

2.3 TOPSOIL MATERIALS

- A. Topsoil: Conforming to PennDOT Publication 408, Sections 801 and 802.

2.4 COMPOST MATERIALS

- A. Compost: Conforming to PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.

2.5 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil and Topsoil Material: Perform in accordance with ASTM D1557.
- B. When tests indicate materials do not meet specified requirements, change material and retest.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials, subsoil, and topsoil not intended for reuse from site.
- D. Remove excavated materials not meeting requirements for subsoil material and topsoil materials from site.
- E. Subsoil area beneath the compost shall be loosened to less than 200 psi to a depth of 20" below final topsoil grade. The contractor shall verify that the sub-soil work conforms to the specified depth.

3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated by Owner's Representative.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- F. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 05 13

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
1. Coarse aggregate materials.
 2. Fine aggregate materials.
 3. Clean aggregate materials.
- B. Related Sections:
1. Section 31 05 13 – Soils for Earthwork.
 2. Section 31 22 13 – Rough Grading.
 3. Section 31 23 16.13 – Trenching.
 4. Section 31 23 23 – Fill.
 5. Section 31 25 00 – Erosion Controls.
 6. Section 32 12 16 – Asphalt Paving.
 7. Section 32 13 13 – Concrete Paving.
 8. Section 32 91 19 – Landscape Grading.
 9. Section 33 10 00 - Water Utilities.
 10. Section 33 30 00 - Sanitary Sewer Utilities.
 11. Section 33 41 00 – Storm Utility Drainage Piping.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- C. PennDOT Publication 408, current edition.

- D. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 SUBMITTALS

- A. Materials Source: Submit name of imported materials suppliers.
- B. Manufacturer's Certificate: Certify Products meet or exceed PennDOT Publication 408 standards.

1.6 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work in accordance with PennDOT Publication 408 standards.
- C. Perform Work in accordance with the Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Type C. Conforming to PennDOT Publication 408, Section 703.2.

2.2 CLEAN COARSE AGGREGATE MATERIALS

- A. Conforming to PennDOT Publication 408, Section 703.2.
- B. Pipe Bedding and Backfill to be AASHTO #57 stone.
- C. Subsurface drainage aggregate including subbase for reinforced turf surfaced parking and driveways to be AASHTO #57 stone.
- D. All material is to be clean-washed prior to installation.

2.3 FINE AGGREGATE MATERIALS

- A. Conforming to PennDOT Publication 408, Section 703.1.

2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and inspection services.
- B. Coarse Aggregate Material (including Clean Aggregate Materials) - Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, AASHTO T180, ASTM D4318, ASTM C136, and PennDOT Bulletin 15.
- C. Fine Aggregate Material - Testing and Analysis: Perform in accordance with D698, ASTM D1557, AASHTO T180, ASTM D4318, ASTM C136, and PennDOT Bulletin 15.

- D. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Remove excess excavated materials, coarse aggregate materials, and fine aggregate materials not intended for reuse from site.
- B. Remove excavated materials not meeting requirements for coarse aggregate materials, and fine aggregate materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations designated by the Owner's Representative.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 05 16

SECTION 33 05 16.13 – PRECAST CONCRETE UTILITY STRUCTURES

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of Contract”, “Special Conditions” and “Division 1 – General Requirements” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section includes precast concrete utility structures:
 - 1. Precast concrete utility structures.
 - 2. Drainage system catch basins.
 - 3. Drainage system inlets.
 - 4. Pipe ends.
 - 5. Frames and covers.
 - 6. Access hatches.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete type for manhole and structure foundation slab construction.
 - 2. Section 31 23 16 - Excavation: Excavating for structures and foundation slabs.
 - 3. Section 31 23 23 - Fill: Backfilling after structure installation.
 - 4. Section 33 10 00 - Water Utilities.
 - 5. Section 33 30 00 - Sanitary Sewer Utilities.
 - 6. Section 33 41 00 - Storm Utility Drainage Piping.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. PennDOT Publication 408, current edition.
- B. PennDOT Publication 72M, RC Standards, current edition.
- C. American Association of State Highway Transportation Officials:
 - 1. AASHTO M306 - Drainage Structure Castings.
 - 2. AASHTO S99-HB - Standard Specifications for Highway Bridges.
- D. American Concrete Institute:
 - 1. ACI 318 - Building Code Requirements for Structural Concrete.
 - 2. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 - 3. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

E. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
3. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A185/A185M - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
6. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
7. ASTM A497/A497M - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
8. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
9. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
10. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
11. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
12. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
13. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
14. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
15. ASTM C33 - Standard Specification for Concrete Aggregates.
16. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
17. ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
19. ASTM C150 - Standard Specification for Portland Cement.
20. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
21. ASTM C192/C192M - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
22. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
26. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
27. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
28. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
29. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

30. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Section Precast Concrete Water and Wastewater Structures.
31. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
32. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
33. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
34. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
35. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
36. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
37. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test prior to Backfill.
38. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
39. ASTM C1433 - Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.
40. ASTM C1504 - Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts, Storm Drains, and Sewers.

F. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

G. National Precast Concrete Association:

1. NPCA Quality Control Manual for Precast Plants.
2. NPCA Plant Certification Program.

H. SSPC: The Society for Protective Coatings:

1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Indicate structure locations, elevations, sections, equipment supports, piping, conduit, sizes and elevations of penetrations.

1.6 QUALITY ASSURANCE

A. Excavate test pits prior to ordering any materials to verify tie in elevations of existing subsurface structures. Invert information to be provided to design engineer.

- B. Obtain precast concrete utility structures from single source.
- C. Perform structural design in accordance with ACI 318.
- D. Perform Work in accordance with NPCA Quality Control Manual for Precast Plants.
- E. Conform to the following for material and fabrication requirements:
 - 1. Single Cell Box Culverts: ASTM C1433.
 - 2. Multiple Cell Box Culverts.
 - 3. Three Sided Structures: ASTM C1504.
 - 4. Other Structures: ASTM C913.
- F. Perform welding in accordance with the following:
 - 1. Structural Steel: AWS D1.1.
 - 2. Reinforcing Steel: AWS D1.4.
- G. Perform Work in accordance with all applicable Federal, State, County, Local Municipal and PennDOT Publications 72M and 408, current editions.

1.7 QUALIFICATIONS

- A. Manufacturer: Certified by NPCA Plant Certification Program prior to and during Work of this section.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast structures. Lift structures from designated lifting points.
- C. Do not deliver products until concrete has cured 5 days or attained minimum 75 percent of specified 28 day compressive strength.
- D. Store precast concrete structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- E. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Design structures for minimum loads conforming to ASTM C857 and ASTM C890.

2.2 PRECAST CONCRETE UTILITY STRUCTURES

- A. Manufacturers to be selected from PennDOT Bulletin 15 Approved Construction Materials
- B. Furnish materials in accordance with all applicable State, local and PennDOT Publications 72M and 408, current editions.
- C. Precast Concrete Utility Structures: Reinforced precast concrete.
- D. Foundation Slab: Cast-in-place Precast concrete of type specified in Section 03 30 00, leveled top surface.
- E. Any deviation from the materials shown on the Drawings requires submission of a stormwater analysis, using the same methodologies and programs as the design, to prove the equivalent material exceeds the materials on the Drawings as well as submissions to all affected reviewing agencies to modifications to their permits. Absent of this information, the contractor is to pay the design professional for the necessary calculations to prove the materials exceed the designed material as well as for any changes to permits.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C33, except gradation requirements do not apply.
- C. Water: Clean and not detrimental to concrete.

2.4 CONCRETE REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, plain billet bars, epoxy coated finish.
- B. Reinforcing Wire:
 - 1. Plain Wire: ASTM A82/A82M; epoxy coated.
 - 2. Deformed Wire: ASTM A496 epoxy coated.
- C. Welded Steel Wire Fabric:
 - 1. Plain Wire: ASTM A185/A185M; unfinished.
 - 2. Deformed Wire: ASTM A497/A497M; unfinished.
- D. Reinforcing Steel Finishes:
 - 1. Galvanized Finish: ASTM A767/A767M, Class I.
 - 2. Epoxy Coating Finish: ASTM A775/A775M.
- E. Wire and Wire Fabric Finishes:
 - 1. Epoxy Coated Finish: ASTM A884/A884M, Class A finish.

2.5 FRAMES AND COVERS

- A. Manufacturers to be selected from PennDOT Bulletin 15 Approved Construction Materials
- B. Furnish materials in accordance with all applicable State, local and PennDOT Publications 72M and 408, current editions.

2.6 ACCESSORIES

- A. Membrane Curing Compound: ASTM C309 Type 1 Class B.
- B. Steps: Formed aluminum rungs.
 - 1. Diameter: 3/4 inch.
 - 2. Width: 12 inches.
 - 3. Spacing: 16 inches on center vertically. As indicated on Drawings, in accordance with PennDOT 72M Standards.
- C. Inserted and Embedded Items:
 - 1. Structural Steel Sections: ASTM A36/A36M; galvanized.
- D. Joint Sealants and Joint Gaskets:
 - 1. Gasket Joints for Circular Concrete Pipe: ASTM C443; standard rubber gaskets.
 - 2. External Sealing Bands: ASTM C877; Type I rubber and mastic bands.
 - 3. Preformed Joint Sealants for Concrete Pipe and Box Sections: ASTM C990.
 - 4. Elastomeric Joint Sealants: ASTM C920; silicone; Grade NS, Class 25; manufactured by.
- E. Pipe Entry Connectors: ASTM C923.
- F. Grout:
 - 1. Cement Grout: Portland cement, sand and water mixture with stiff consistency to suit intended purpose.
 - 2. Non-Shrink Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days; manufactured by.
- G. Bituminous Coating:
 - 1. Manufacturers:
 - a. Per PennDOT approved vendors
- H. Touch-Up Primer for Galvanized Surfaces: SSPC 20 Type II Organic.

2.7 CONCRETE MIX

- A. Select proportions for normal weight concrete in accordance with ACI 318. and ACI 211.1.
- B. Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923
- C. Admixtures: Include admixture types and quantities indicated in concrete mix designs approved through submittal process.
 - 1. Do not use calcium chloride.

2.8 FABRICATION

- A. Fabricate precast concrete utility structures in accordance with ACI 318. and NPCA Quality Control Manual for Precast Plants.
- B. Fabricate precast concrete utility structures to size, configuration, knock out panels, and openings as indicated on Drawings.
- C. Construct forms to provide uniform precast concrete units with consistent dimensions.
- D. Clean forms after each use.
- E. Install reinforcing by tying or welding to form rigid assemblies. Position reinforcing to maintain minimum 1/2 inch cover. Secure reinforcement to prevent displacement when placing concrete.
- F. Position and secure embedded items to prevent displacement when placing concrete.
- G. Deposit concrete in forms. Consolidate concrete without segregating aggregate.
- H. Provide initial curing by retaining moisture using one of the following methods:
 - 1. Cover with polyethylene sheets.
 - 2. Cover with burlap or other absorptive material and keep continually moist.
 - 3. Apply curing compound in accordance with manufacturer's instructions.
- I. Provide final curing in accordance with manufacturer's standard.
- J. Remove forms without damaging concrete.

2.9 CONCRETE FINISHES

- A. Formed Surfaces Not Exposed to View: As formed.
- B. Unformed Surfaces: Finish with vibrating screed or hand float.
 - 1. Permitted: Color variations, minor indentations, chips, and spalls.
 - 2. Not Permitted: Major imperfections, honeycomb, or other defects.
- C. Exposed to View Finishes: Troweled light broom

2.10 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Visually inspect completed precast structures for defects.
 - 1. Repair defects affecting exposed to view surfaces to achieve uniform appearance.
 - 2. Repair honeycomb by removing loose material and applying grout to produce smooth surface flush with adjacent surface.
 - 3. Repair major defects only when permitted by Owner's Representative.
- C. Make test results available to Owner's Representative upon request.

2.11 FINISHING - STEEL

- A. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.

PART 3 – EXECUTION*

3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify correct size and elevation of excavation.
- C. Verify subgrade and bedding is properly prepared, compacted and ready to receive Work of this section.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast concrete structures immediately prior to placement in excavation to verify are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

- A. Install underground precast utility structures in accordance with ASTM C891 and manufacturer specifications.
- B. Lift precast concrete structures at lifting points designated by manufacturer.
- C. When lowering structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

- D. Install precast concrete base to elevation and alignment indicated on Drawings.
- E. Install cast-in-place concrete foundation slab in accordance with Section 03 30 00, trowel top surface level.
- F. Install precast concrete utility structures to elevation and alignment indicated on Drawings.
- G. Assemble multi-section structures by lowering each section into excavation.
 - 1. Clean joint surfaces.
 - 2. Install watertight joint seals in accordance with manufacturer's instructions using gasket joints, or.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with grout.
- I. Connect pipe to structure and seal watertight. Cut pipe flush with interior of structure.
- J. Grout base to achieve slope to exit piping. Trowel smooth. Contour as indicated on Drawings.
- K. Paint interior with 2 coats of bituminous interior coating at rate of 120 square feet per gallon for each coat.
- L. Set frame and cover and access hatch level without tipping, to elevations indicated on Drawings.
 - 1. Set cover and access hatch 2 inches above finished grade for structures located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
 - 2. Connect drain from access hatch frame to storm drainage system.
- M. Touch up damaged galvanized coatings.
- N. Backfill excavations for structures in accordance with Section 31 23 23.
- O. Install Work in accordance with all applicable State, local and PennDOT Publications 72M and 408, current editions.
- P. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION 33 05 16.13

SECTION 31 05 19.13 - GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
 - 1. Erosion Control Matting.
 - 2. Nonwoven geotextile material.
- B. Related Requirements:
 - 1. Section 31 23 23 - Fill: Backfilling required at building perimeter and Site structures to subgrade elevations; fill under slabs on grade, pavement, and landscaped areas.
 - 2. Section 31 25 00 - Erosion and Sedimentation Controls: Erosion and sedimentation control devices.
 - 3. Section 32 11 23 - Aggregate Base Courses: Subbase and base course for placement under paving.
 - 4. Section 32 91 19 - Landscape Grading: Placing, leveling, and compacting topsoil materials prior to final landscaping.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
- B. ASTM International:
 - 1. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 - 2. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 3. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - 4. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

5. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 6. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 7. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
 8. ASTM D4884/D4844M - Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles.
 9. ASTM D4886 - Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).
 10. ASTM D6524 - Standard Test Method for Measuring the Resiliency of Turf Reinforcement Mats (TRMs).
 11. ASTM D6525/D6525M - Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products.
 12. ASTM D6566 - Standard Test Method for Measuring Mass per Unit Area of Turf Reinforcement Mats.
 13. ASTM D6567 - Standard Test Method for Measuring the Light Penetration of a Turf Reinforcement Mat (TRM).
 14. ASTM D6575 - Standard Test Method for Determining Stiffness of Geosynthetics Used as Turf Reinforcement Mats (TRMs).
 15. ASTM D6818 - Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products.
- C. PennDOT Publication 408, current edition.
- D. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012.
- E. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information including tensile strength, elongation, thickness, UV resistance, and other material specifications.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Qualifications Statements:
1. Submit qualifications for manufacturer and installer.
 2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of geotextile material, including placement depth. Provide photographs of geotextile in-place.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Verify manufacturer's requirements.

1.8 QUALITY ASSURANCE

- A. Perform Work according to Drawings and Conservation District standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Comply with ASTM D4873.
- D. Store materials according to manufacturer instructions.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 EROSION CONTROL MATTING

- A. Manufacturers: Furnish materials according to Drawings and Conservation District standards.
- B. Description: Machine-produced mat of 100% agricultural straw covered with a light-weight, photo-degradable, polypropylene netting.
- C. Performance and Design Criteria:
 - 1. Comply with AASHTO M288.

2. Mass per Unit Area: Comply with ASTM D6566.
3. Thickness: Comply with ASTM D6525.
4. Light Penetration: Comply with ASTM D6567.
5. Tensile Strength (Grab): Comply with ASTM D4632.
6. Maximum Elongation: Comply with ASTM D6818.
7. Resiliency: Comply with ASTM D6524.
8. Average Flexibility: Comply with ASTM D6575.
9. Functional Longevity: Between 9 – 12 months.

2.2 NONWOVEN GEOTEXTILE MATERIALS

- A. Manufacturers: Furnish materials according to Drawings and Conservation District standards.
- B. Description:
 1. Non-biodegradable, UV-resistant, nonwoven geotextile fabric.
 2. Calendar such that yarns will retain relative positions.
- C. Performance and Design Criteria: Comply with ASTM D4491.
 1. Wide-Width Strip Tensile Strength: Comply with ASTM D4632/D4632M.
 2. Elongation: Comply with ASTM D4632/D4632M.
 3. Trapezoidal Tear Strength: Comply with ASTM D4533/D4533M.
 4. Puncture Strength: Comply with ASTM D4833/D4833M.
 5. UV Resistance at 500 Hours: Comply with ASTM D4355/D4355M.

2.3 ACCESSORIES

- A. Securing Pins: Per Manufacturer Specifications
- B. Wire Staples: Per Manufacturer Specifications

2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Install slope stabilization matting on all surfaces with a slope 3:1 or steeper

Verify that underlying surface is smooth and free of ruts or protrusions that could damage geotextile material.

3.2 PREPARATION

- A. Subgrade Material and Compaction Requirements: Contact Owner's Representative for inspection and approval of subgrade 48 hours prior to installation of geotextile material.

3.3 INSTALLATION

- A. Geotextile Material:
 - 1. Lay and maintain smooth and free of tensile stresses, folds, wrinkles, or creases.
 - 2. Ensure that material is in direct contact with subgrade.
- B. Securement Pins:
 - 1. Install per manufacturers requirements
 - 2. Ensure that washer bears against geotextile.
- C. Seams:
 - 1. Install per manufacturers requirements
- D. Penetrations: As indicated on Drawings
- E. Repairing Damaged Geotextiles:
 - 1. Repair torn or damaged geotextile by overlapping a new piece beyond edge of damaged area, and fasten as recommended by geotextile manufacturer.
 - 2. Remove and replace geotextile rolls which cannot be repaired.
- F. Fill and Cover:
 - 1. Place fill to prevent tensile stress or wrinkles in geotextile.
 - 2. Place fill from bottom of side-slopes upward.
 - 3. Do not drop fill from height greater than 3 feet.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

3.5 PROTECTION

- A. Ballast: Adequate to prevent uplift of material by wind.
- B. UV Exposure: Do not leave material uncovered for more than 14 days after installation.
- C. Do not operate equipment directly on top of geotextile.

END OF SECTION 31 05 19.13

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
1. Removing paving, curbs, and sidewalks as needed to complete work.
 2. Removing trees, shrubs, and other plant life as needed to complete work.
 3. Removing abandoned utilities and storm piping.
 4. Remove foundation bases and utility pads.
 5. Removal of all items identified and not identified on the site and architectural Drawings as needed to complete work.
- B. Related Sections:
1. Section 31 22 13 – Rough Grading.
 2. Section 31 25 00 – Erosion Controls.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.
- B. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc. dated September 26, 2017.

1.5 SUBMITTALS

- A. Provide an OSHA compliant safety plan for the project to the Owner's Representative prior to starting work. Maintain one (1) copy on-site. The safety plan shall address the specific safety / compliance concerns applicable to its activities in the field, shop, and office such as the following:

- Site Specific Safety Concerns and Standard Operating Procedures
- Personal Protective Equipment (PPE)
- HAZCOM/Right to Know
- Lockout/Tagout Knowledge and Training
- Illness/Injury Recordkeeping and Posting
- OSHA Poster Review
- Reporting Serious Accidents
- Training

- B. Weekly safety meetings shall be conducted with all site employees and documentation including meeting minutes and sign-in sheets shall be submitted. These meetings shall deal with specific relevant safety issues as they relate to the work.

1.6 QUALITY ASSURANCE

- A. All specifications shall conform to PennDOT Publication 408, current edition.
- B. Perform Work in accordance with PA DEP regulations.
- C. Perform Work in accordance with OSHA regulations.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.

3.2 PREPARATION

- A. Contact Owner's Representative not less than 3 working days before calling Local Utility Line Information Service and not less than 5 working days before performing Work.
- B. Call Local Utility Line Information Service at 811 not less than three working days before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

- A. Locate, identify, and protect utilities indicated on the Drawings as to remain, from damage.
- B. Protect trees, plant growth, and features designated on the Drawings to remain.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs within designated limits of disturbance and listed as to be removed.

3.5 REMOVAL

- A. Remove existing foundations, drainage pipes, and structures not being utilized with the project, reset existing structures; removal of debris, rock, stone, and extracted plant life from site as depicted on plans.
- B. Remove paving, curbs, and sidewalks as indicated on Drawings. Neatly saw cut edges at right angle to surface.
- C. Remove abandoned utilities and storm pipes as indicated on the Drawings. Indicated removal termination point for underground utilities on Record Documents. Coordinate work with utility companies.
- D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. Do not burn or bury materials on site. Leave site in clean condition.

3.6 RELOCATION

- A. Relocate utilities encountered within the project limits to maintain service outside of the work zone.

3.7 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil or material.
- C. Stockpile in area designated on site and protect from erosion.
- D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION 31 10 00

SECTION 31 22 13 - ROUGH GRADING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
1. Excavating topsoil.
 2. Excavating subsoil.
 3. Cutting, grading, filling, rough contouring, and compacting site for structures, building pads, and utilities.
- B. Related Sections:
1. Section 31 05 13 - Soils for Earthwork: Soils for fill.
 2. Section 31 05 16 - Aggregates for Earthwork: Aggregates for fill.
 3. Section 31 10 00 - Site Clearing: Excavating topsoil.
 4. Section 31 23 16 - Excavation: Building excavation.
 5. Section 31 23 16.13 - Trenching: Trenching and backfilling for utilities.
 6. Section 31 23 23 - Fill: General building area backfilling.
 7. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
 3. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 4. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
 8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- C. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.
- D. Geotechnical Exploration Report, Northview Heights Midrise, Prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 SUBMITTALS

- A. Materials Source: Submit name of imported materials suppliers.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.
- B. Perform Work in accordance with Conservation District standards.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Section 31 05 13 – Soils for Earthwork: Topsoil and subsoil fill.
- B. Section 31 05 16 – Aggregates for Earthwork: Structural and General fill.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions for the Work are in accordance with the Drawings.
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Contact Owner's Representative not less than 5 working days before performing Work.
- B. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- C. Identify required lines, levels, contours, and datum.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL AND SUBSOIL EXCAVATION

- A. Section 31 05 13 – Soils for Earthwork: Use topsoil from areas to be further excavated, re-landscaped, or regraded without mixing with foreign materials for use in finish grading.
- B. Section 31 23 16 – Excavation: Do not excavate wet topsoil.
- C. Stability: Replace damaged or displaced subsoil as specified for fill.

3.4 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise on the Drawings.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Repair or replace items indicated to remain damaged by excavation or filling.

3.5 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 feet from required elevation.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements-: Field inspecting, testing, adjusting, and balancing.

- B. Perform laboratory material tests in accordance with ASTM D1557, ASTM D698, or AASHTO T180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION 31 22 13

SECTION 31 23 16 - EXCAVATION

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.
- B. Excavation for this Project shall be considered unclassified and shall include all types of earth and soil, any pebbles, boulders, and bedrock, mine spoils, municipal trash, rubbish and garbage and all types of debris of the construction industry such as wood, stone, concrete, plaster, brick, mortar, steel and iron shapes, pipe, wire, asphaltic materials, paper and glass. Unclassified excavation does not include unforeseen concrete foundations, walls, or slabs. All such materials encountered which are identified by this paragraph as unclassified shall be removed to the required widths and depths to create a finished product as shown and/or noted on the drawings and as written in the specifications. No additional compensation shall be made to the contractor for this unclassified excavation. The materials defined by this paragraph as unclassified will not be considered to be concealed conditions or unknown physical conditions below the surface of the ground for purposes of interpreting the language in the General Conditions of the Construction Contract.

Any available data concerning subsurface materials or conditions based on soundings, test pits or test borings, has been obtained by the Owner for its own use in designing this Project. The Contractor accepts full responsibility for any conclusions drawn with respect to conditions on site. Bidders shall therefore undertake to perform their own investigation of existing subsurface conditions. The Owner will not be responsible in any way for the consequences of the Contractor's failure to conduct such investigation. Excavation for the Project is considered "unclassified", as fully described below.

1.2 SUMMARY

- A. Section Includes:
 - 1. Excavating for Stormwater Facilities.
 - 2. Excavating for Foundations.
 - 3. Excavating for Site Structures.
 - 4. Excavating for Utility and Stormwater Facilities.
 - 5. Excavating for Landscaping.
- B. Related Sections:
 - 1. Section 02 41 00 – Demolition.
 - 2. Section 31 05 13 – Soils for Earthwork.
 - 3. Section 31 05 16 – Aggregates for Earthwork.
 - 4. Section 31 22 13 – Rough Grading.
 - 5. Section 31 23 16.13 – Trenching.
 - 6. Section 31 23 19 – Dewatering.
 - 7. Section 31 23 23 – Fill.
 - 8. Section 33 05 16.13 – Precast Concrete Utility Structures.
 - 9. Section 33 10 00 - Water Utilities.
 - 10. Section 33 30 00 - Sanitary Sewer Utilities.
 - 11. Section 33 41 00 – Storm Utility Drainage Piping.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. Local utility standards when working within 24 inches of utility lines.
- B. PennDOT Publication 408, current edition.
- C. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.
- D. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with PennDOT Publication 408, current edition.

1.6 QUALIFICATIONS – NOT USED

PART 2 - PRODUCTS- NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Contact Owner's Representative not less than 5 working days before performing Work.
- B. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- C. Identify required lines, levels, contours, and datum.
- D. Notify utility company to remove and relocate utilities.
- E. Protect utilities indicated to remain from damage.
- F. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
- G. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 EXCAVATION

- A. Excavate subsoil to accommodate building foundations, slabs-on-grade, paving and site structures and construction operations to the required depth as shown on the plans, or as needed to complete the work.

- B. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 23 – Fill and Section 31 23 16.13 Trenching.
- C. Slope banks with machine to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume. Remove larger material as specified in Section 31 23 23 – Fill.
- H. Notify Owner's Representative of unexpected subsurface conditions.
- I. Correct areas over excavated with structural fill as directed by Geotechnical Engineer.
- J. Remove excess and unsuitable material from site.
- K. Stockpile excavated material in area designated on site in accordance with Section 31 05 13 – Soils for Earthwork.
- L. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Approval of Bearing Strata
 - 1. The Contractor shall furnish adequate advance notification to the Owner's Representative of times when footing excavations are to be completed, so that the bearing quality of bottoms may be inspected and/or tested and approved. Formwork and concreting shall follow only after this approval.
 - 2. Should the bearing at the levels indicated be found by the Owner's Representative and the Owner to be inadequate, they may order the excavation carried down to sound bearing. Such excavation shall be classed as additional work and payment be made on the basis of an agreed price according to the General Conditions. Should suitable bearing be found at a lesser depth than indicated, the Owner's Representative and the Owner may order the reduction of excavation specified or shown on the drawings, and the Contractor shall allow a credit for excavation thus omitted on the same basis.
 - 3. Request inspection of excavation and controlled fill operations in accordance with applicable code.
- C. Quality Control Testing
 - 1. The Contractor shall perform all necessary Quality Control tests and procedures for the performance of the work to produce end results specified. The Contractor shall maintain clear and orderly records of such tests and procedures and make them available for field review and approval of the Owner's Representative. The Contractor's bid shall include the cost of all Quality Control Tests.

2. The Contractor shall submit its plan for Quality Control testing to the Owner's Representative for review and comments.
3. Quality Control tests shall include tests on fill material, optimum moisture content and maximum density and field density tests of fill layers.
4. The Contractor shall request consultation with the Consulting Geotechnical Engineer on any problems that arise during construction.
5. The Contractor shall approve each subgrade and each fill layer before proceeding to the next layer. Any area which does not meet density, % moisture or other requirements at any time, shall be suitably reworked and retested by the Contractor at his own expense.

3.4 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION 31 23 16

SECTION 31 23 16.13 - TRENCHING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
1. Compacted fill from top of utility bedding to subgrade elevations.
 2. Backfilling and compaction.
- B. Related Sections:
1. Section 03 30 00 – Cast-In-Place Concrete.
 2. Section 31 05 13 – Soils for Earthwork.
 3. Section 31 05 16 – Aggregates for Earthwork.
 4. Section 31 22 13 – Rough Grading.
 5. Section 31 23 16 – Excavation.
 6. Section 31 23 23 – Fill.
 7. Section 32 91 19 – Landscape Grading.
 8. Section 33 10 00 - Water Utilities
 9. Section 33 30 00 - Sanitary Sewer Utilities.
 10. Section 33 41 00 – Storm Utility Drainage Piping.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

- C. PennDOT Publication 72M, RC Standards, current edition.
- D. PennDOT Publication 213, current edition.
- E. PennDOT Publication 408, current edition.
- F. Local Utility Company Standards and Details.
- G. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

1.6 SUBMITTALS

- A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with PennDOT Publication 408, current edition.

1.8 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Pennsylvania.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. General Fill: As specified in Section 31 05 13 – Soils for Earthwork.
- B. Structural Fill: As specified in Section 31 05 13 – Soils for Earthwork and Section 31 05 16 – Aggregates for Earthwork.

PART 3 - EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. Owner's Representative reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Contact Owner not less than 5 working days before performing Work.
- B. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- C. Identify required lines, levels, contours, and datum locations.
- D. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- E. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCHING

- A. Excavate subsoil required for utilities to utility service.
- B. Remove lumped subsoil, boulders, and rock up of 1/3 cubic yard, measured by volume.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
- D. Do not advance open trench more than 200 feet ahead of installed pipe.
- E. Cut trenches to width indicated on Drawings. Remove water or materials that interfere with Work in accordance with Conservation District requirements and as shown on the Drawings.
- F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- H. Do not interfere with 45 degree bearing splay of foundations.

- I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.
- J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Owner's Representative until suitable material is encountered.
- K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Structural Fill and compact to density equal to or greater than requirements for subsequent backfill material.
- L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- M. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Owner's Representative.
- N. Remove excess subsoil not intended for reuse, from site.
- O. When performing work in or adjacent to an active roadway, ensure compliance with PennDOT standards for maintenance and protection of traffic.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches excavated through unstable, loose, or soft material regardless of depth. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Minimize compaction in area of infiltration basin.
- D. Place material in continuous layers as follows:
 - 1. **General Fill:** Maximum 8-inch loose lifts utilizing heavy compaction equipment.
Maximum 4-inch loose lifts when utilizing relatively light compaction equipment.
 - 2. **Structural Fill:** Maximum 8-inch loose lifts utilizing heavy compaction equipment.
Maximum 4-inch loose lifts when utilizing relatively light compaction equipment.

- E. Employ placement method that does not disturb or damage foundation perimeter drainage, utilities in trench.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Do not leave trench open at end of working day.
- H. Protect open trench to prevent danger to the public.

3.6 TOLERANCES

- A. Top Surface of Backfilling Under Paved Areas: Plus or minus ½ inch from required elevations.
- B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Perform all work in accordance with Section 31 23 16 - Excavation.

3.8 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 31 23 16.13

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY:

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
 - 1. Implementation of the Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 REQUIREMENT:

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated and concrete placed, in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
 - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
 - 2. Erosion is controlled.

3. Flooding of excavations or damage to structures does not occur.
 4. Surface water drains away from excavations.
 5. Excavations are protected from becoming wet from surface water, or ensure excavations are dry before additional work is undertaken.
- G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Excavation, backfilling, site grade and utilities: Sections 31 23 16, EXCAVATION and 31 23 16.13, TRENCHING.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
 1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
 2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
 3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
 4. Capacities of pumps, prime movers, and standby equipment.
 5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include

the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.

6. Detailed description of dewatering procedure and maintenance method.
7. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

- C. Inspection Reports.
- D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

- A. Dispose of water removed from the excavations in such a manner as:
 1. Will not endanger portions of work under construction or completed.
 2. Will cause no inconvenience to Owner or to others working near site.
 3. Will comply with the stipulations of required permits for disposal of water.

4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:
1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
 2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
 3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
 4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT:

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain de-watering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Owner.

3.6 DAMAGES:

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

Ensure compliance with all conditions of regulating permits and provide such information to the Owner's Representative. Obtain written approval from Owner's Representative before discontinuing operation of dewatering system.

END OF SECTION 31 23 19

SECTION 31 23 23 - FILL

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Backfilling site structures to subgrade elevations.
2. Fill under slabs-on-grade.
3. Fill for over-excavation.
4. Fill under paving operations.
5. Fill for soils amendment areas.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete.
2. Section 31 05 13 – Soils for Earthwork.
3. Section 31 05 16 – Aggregates for Earthwork.
4. Section 31 22 13 – Rough Grading.
5. Section 31 23 16 – Excavation.
6. Section 31 23 16.13 – Trenching.
7. Section 31 25 00 – Erosion Control.
8. Section 32 91 19 – Landscape Grading.
9. Section 33 05 16.13 – Precast Concrete Utility Structures.
10. Section 33 10 00 - Water Utilities.
11. Section 33 30 00 - Sanitary Sewer Utilities.
12. Section 33 41 00 – Storm Utility Drainage Piping.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

- C. PennDOT Publication 408, current edition.
- D. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections
- E. Geotechnical Exploration Report, Northview Height Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported fill materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed PADEP requirements for residential clean fill.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with PennDOT Publication 408.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. General Fill: As specified in Section 31 05 13 – Soils for Earthwork.
- B. Structural Fill: As specified in Section 31 05 13 – Soils for Earthwork. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand with at least 90 percent passing a 1-1/2-inch sieve and not more than 20 percent passing a No. 200 sieve and with a plasticity index not greater than 8 percent. Recycled concrete is considered suitable for use as engineered fill even though the percent passing the No. 200 sieve may be greater than 20 percent. Imported fill material shall be approved by Geotechnical Engineer well in advance of fill construction. Structural fill shall comply with the recommendations of the Geotechnical Report.

2.2 ACCESSORIES – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions for the Work are in accordance with the Drawings.
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface to depth of 6 inches.
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place material in continuous layers as follows:
 - 1. **General Fill:** Maximum 8-inch loose lifts utilizing heavy compaction equipment.
Maximum 4-inch loose lifts when utilizing relatively light compaction equipment.
 - 2. **Structural Fill:** Maximum 8-inch loose lifts utilizing heavy compaction equipment.
Maximum 4-inch loose lifts when utilizing relatively light compaction equipment.
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Make gradual grade changes. Blend slope into level areas.
- G. Remove surplus backfill materials from site.
- H. Leave fill material stockpile areas free of excess fill materials.
- I. Structural fill shall be compacted to at least 95 percent of the laboratory determined maximum dry density as determined by ASTM D1557 (Modified Proctor) methods for subgrade and/or beneath foundations and/or structural elements and 90 percent of the laboratory determined maximum dry density for subgrade not beneath structural elements or behind foundations.

3.4 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Perform all work in accordance with Section 31 23 16 – Excavation, and the Geotechnical Exploration Report.

3.6 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic.

3.7 SOIL LOOSENING

- A. Perform in accordance with Drawings.

3.8 SOILS AMENDMENT AND RESTORATION

- A. Perform in accordance with Drawings.

END OF SECTION 31 23 23

SECTION 31 25 00 - EROSION CONTROLS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full

1.2 SUMMARY

- A. This section includes various erosion and sedimentation (E&S) control devices that may function in any particular combination as an erosion control system for transportation and site development applications. This work shall consist of temporary control measures ordered by the Owner's Representative during the life of the contract and as shown on the plans, to control erosion and sediment with dikes, berms, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, and other erosion control devices or methods.
- B. The temporary control provisions contained herein shall be coordinated with the permanent erosion control features (grass, pavement and other restorations) specified elsewhere in the contract to the extent practical to assure economical, effective and continuous erosion control throughout the construction and post-construction period.
- C. The erosion control measures described herein shall be continued until the construction is complete and final restorations installed.
- D. Section Includes:
 - 1. E&S Controls as detailed on the Drawings.
 - 2. When required, Critical Stage Site Inspections by a Licensed Professional or Designee as detailed on the Drawings including their certification on the Notice of Termination.
- E. Related Sections:
 - 1. Section 31 05 13 - Soils for Earthwork.
 - 2. Section 31 05 16 - Aggregates for Earthwork.
 - 3. Section 31 10 00 - Site Clearing.
 - 4. Section 31 23 16 - Excavation.
 - 5. Section 31 23 23 - Fill.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T88 - Standard Specification for Particle Size Analysis of Soils.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- B. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
- C. ASTM International:
 - 1. ASTM C127 - Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m<sup>3 - 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m<sup>3 - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>
- D. Precast/Prestressed Concrete Institute:
 - 1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- E. PennDOT Publication 408, current edition.
- F. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.
- G. Geotechnical Exploration Report, Northview Heights Midrise, prepared by Sci-Tek Consultants, Inc., dated September 26, 2017.

1.5 SUBMITTALS

- A. Product Data: Submit data on geotextile.

1.6 CLOSEOUT SUBMITTALS

- A. Provide final inspection certification from the City.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with 25 Pa. Code, Chapter 102; PADEP Erosion and Sediment Pollution Control Program Manual; and PennDOT Publication 408 standards. In the event of conflict between these requirements and pollution control laws, rules, or regulation of other federal, state, or local agencies, the more restrictive law, rule, or regulation shall govern.

1.8 PRE-INSTALLATION MEETINGS

- A. Set-up a pre-construction meeting a minimum of one week prior to commencing any work on the property with representatives of the Owner, Township, and Conservation District.

PART 2 - PRODUCTS

2.1 ROCK AND GEOTEXTILE MATERIALS

- A. Rock: Furnish in accordance with the Drawings and with Section 31 05 16 – Aggregates for Earthwork.
- B. Geotextile Fabric: Furnish in accordance with the Drawings and with Section 31 05 19.13 – Geotextiles for Earthwork.

2.2 PLANTING MATERIALS

- A. Seeding and Soil Supplements: As specified on the Drawings and in Section 32 92 19 - Seeding. Furnish in accordance with drawings and PennDOT Publication 408 Standards.
- B. Mulch: as specified in Section 32 92 19 - Seeding. Furnish in accordance with Drawings, Conservation District, and PennDOT Publication 408 Standards.

2.3 PIPE MATERIALS

- A. Cleaning of existing and proposed structures and pipes filled with sediment: Includes the removal, hauling, and disposal of sediment and other debris in the system.

2.4 MIXES

- A. Compost Mix: As specified on the Drawings and in Section 31 05 13 – Soils for Earthwork.

2.5 SOURCE QUALITY CONTROL (AND TESTS)

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.
- B. Verify gradients and elevations of base or foundation for other work are correct.

3.2 ROCK CONSTRUCTION ENTRANCE

- A. Install at the locations specified and in accordance with the Drawings.
- B. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.3 COMPOST FILTER SOCKS

- A. Install at the locations specified and in accordance with the Drawings.
- B. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.4 INLET PROTECTION

- A. Install at the locations specified and in accordance with the Drawings.
- B. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.5 EROSION CONTROL LINING

- A. Install when grades exceed 3:1 slopes and at the locations specified and in accordance with the Drawings.
- B. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.6 CONSTRUCTION FENCING

- A. Install at the locations specified and in accordance with the Drawings.
- B. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.7 SOILS AMENDMENTS AND RESTORATION

- A. Follow inspection, maintenance, and repair information as listed on the Drawings and in Section 31 23 23 - Fill.

3.8 PUMPED WATER FILTER BAG

- A. Follow inspection, maintenance, and repair information as listed on the Drawings

3.9 ROCK FILTER OUTLET

- A. Follow inspection, maintenance, and repair information as listed on the Drawings.

3.10 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2: 1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
 - 1. During non-germinating periods, apply mulch at recommended rates.

2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one-year in accordance with Section 32 92 19 - Seeding at 75% percent of permanent application rate with no topsoil.
3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one-year in accordance with Section 32 92 19 - Seeding permanent seeding specifications.

3.11 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order. Provide photographs to document site conditions.
- C. Provide Engineer with 48 hours prior notice for inspection of critical stage inspections as listed on the Project Drawings. Photo document all critical stages of construction.

3.12 CLEANING

- A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- B. Do not damage structure or device during cleaning operations.
- C. Do not permit sediment to erode into construction or site areas or natural waterways.
- D. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.13 PROTECTION

- A. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit sediment to erode into construction or site areas or natural waterways
- C. Protect infiltration area from receiving sediment laden water or compaction. Install orange safety fence around perimeter of infiltration area prior to construction.

END OF SECTION 31 25 00

SECTION 32 01 90.33 – TREE PRESERVATION

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes the protection and trimming of existing trees that interfere with, or are affected by the execution of the Work, whether temporary or permanent construction.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Tree Pruning Schedule: Written schedule from certified arborist detailing scope and extent of pruning of trees scheduled to remain that interfere with or are affected by construction operations.
- C. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- D. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

1.4 QUALITY ASSURANCE

- A. Arborist Qualifications: An arborist certified by the International Society of Arboriculture (ISA) licensed in the jurisdiction where Project is located.
- B. Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and Other Woody Plant Maintenance--Standard Practices (Pruning)."

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than 10 percent passing a 3/4-inch sieve.
- B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other non-soil materials. Topsoil shall be obtained from on-site sources.
 - 1. In the event that topsoil from on-site sources is insufficient or does not comply with specifications, obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.
- C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.
- D. Chain-Link Fence: Metallic-coated steel chain-link fence fabric of 0.120-inch- diameter wire; a minimum of 48 inches high; with 1.9-inch- diameter line posts; 2-3/8-inch- diameter terminal and corner posts; 1-5/8-inch- diameter top rail; and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
- E. Plastic Construction Fence: Heavy-duty plastic snow fence 4-1/8" x7/8" mesh, color: orange, use with metal 'T' stakes/posts for support.
- F. Organic Mulch: Ground or shredded bark free from deleterious materials.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Temporary Fencing: Install temporary fencing around tree protection zones for groupings of trees or at the drip line of individual trees scheduled to remain. Protect trees and vegetation scheduled to remain from construction damage. Maintain chain link fence or plastic construction fence during construction period. Remove fencing when construction is complete.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems.

3.2 EXCAVATION

- A. Install shoring or other protective support systems to minimize sloping or benching of excavations.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where utility trenches are required within tree protection zones, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.
 - 1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade beyond tree protection zones. Maintain existing grades within tree protection zones.
- B. Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.
- C. Moderate Fill: Where existing grade is more than 6 inches but less than 12 inches below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:
 - 1. Carefully place drainage fill against tree trunk approximately 2 inches above elevation of finish grade and extend not less than 18 inches from tree trunk on all sides. For balance of area within drip-line perimeter, place drainage fill up to 6 inches below elevation of grade.
 - 2. Place filter fabric with edges overlapping 6 inches minimum.
 - 3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.4 TREE PRUNING

- A. Prune trees to remain that are affected by temporary and permanent construction.
- B. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by the arborist.
- C. Pruning Standards: Prune trees according to ANSI A300 (Part 1) as follows:
 - 1. Type of Pruning: Thinning, Raising, and Reduction.
- D. Cut branches with sharp pruning instruments; do not break or chop.
- E. Chip removed tree branches and dispose of off-site.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to arborist's written instructions.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted.
- B. Disposal: Remove excess excavated material and displaced trees from the Owner's property.

END OF SECTION 32 01 90.33

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:

1. Aggregate subbase.

- B. Related Sections:

1. Section 31 05 16 - Aggregates for Earthwork.
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 16.13 - Trenching.
4. Section 31 23 23 - Fill.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCES

- A. American Association of State Highway and Transportation Officials:

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
3. AASHTO T 310 - Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

- B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D2940 - Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

- C. PennDOT Publication 408, current edition.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Submit data for geotextile fabric.
- B. Materials Source: Submit name of aggregate materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed PennDOT Publication 408 standards.

1.6 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work in accordance with PennDOT Publication 408 standard.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Subbase Aggregate: PennDOT Type 2A, in accordance with PennDOT Publication 408.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate with 20-ton vibratory roller in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23 - Fill.
- B. Verify substrate has been inspected, gradients and elevations are correct.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to total compacted thickness indicated on Drawings.
- B. Roller compact aggregate to 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D1557). If due to the material gradation, the Modified Proctor Test is not applicable, then compact the material to at least 75 percent of the relative density as determined by ASTM D4253 and D4254.
- C. Level and contour surfaces to elevations, profiles, and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain specified compaction density.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Maximum Variation From Flat Surface: ½ inch measured with 10 foot straight edge.
- B. Maximum Variation From Thickness: 1/4 inch.
- C. Maximum Variation From Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with AASHTO T310.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- C. Frequency of Tests: One test for every 1000 square yards of each layer compacted aggregate.

END OF SECTION 32 11 23

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.

- B. Related Sections:

1. Section 31 23 23 - Fill.
2. Section 31 05 16 - Aggregates for Earthwork.
3. Section 32 17 23 – Pavement Markings.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCES

- A. American Association of State Highway and Transportation Officials:

1. AASHTO M17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
2. AASHTO M29 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
3. AASHTO M140 - Standard Specification for Emulsified Asphalt.
4. AASHTO M208 - Standard Specification for Cationic Emulsified Asphalt.
5. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
6. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.
7. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
8. AASHTO MP1a - Standard Specification for Performance-Graded Asphalt Binder.

- B. Asphalt Institute:

1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.
3. AI SP-2 - Superpave Mix Design.

- C. ASTM International:

1. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

2. ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
3. ASTM D242 - Standard Specification for Mineral Filler For Bituminous Paving Mixtures.
4. ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
5. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
6. ASTM D977 - Standard Specification for Emulsified Asphalt.
7. ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
8. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
9. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).
10. ASTM D2397 - Standard Specification for Cationic Emulsified Asphalt.
11. ASTM D2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
12. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
13. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
14. ASTM D3515 - Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
15. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
16. ASTM D3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal.
17. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
18. ASTM E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
19. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
20. ASTM E1918 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
21. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. PennDOT Publication 72M, RC Standards, current edition.

E. PennDOT Publication 408, current edition.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

C. Manufacturer's Certificate: Certify Products meet or exceed PennDOT Publication 408 standards.

1.6 QUALITY ASSURANCE

A. Mixing Plant: Conform to PennDOT Publication 408 standards.

- B. Obtain materials from same source throughout.
- C. Perform Work in accordance with PennDOT Publication 408 standards.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum 5 years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, surface is wet or frozen, or outside of the paving dates listed in PennDOT Publication 408 unless approved by the Owner's Representative.

PART 2 - PRODUCTS

2.1 ASPHALT MATERIALS

- A. Asphalt Cement: In accordance with PennDOT Publication 408 standards.
- B. Tack Coat: In accordance with PennDOT Publication 408 standards.

2.2 AGGREGATE MATERIALS

- A. Coarse Aggregate: In accordance with Section 31 05 16 – Aggregates for Earthwork. In accordance with PennDOT Publication 408 standards.
- B. Fine Aggregate: ASTM D1073 AASHTO M29; natural sand or sand manufactured from stone, gravel, or blast furnace slag. In accordance with PennDOT Publication 408 standards.

2.3 MIXES

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Paving Mixtures: Designed in accordance with PennDOT Publication 408 standards.
 - 1. Base Course: As indicated on the drawings.
 - 2. Binder Course: As indicated on the drawings.
 - 3. Wearing Course: As indicated on the drawings.

2.4 SOURCE QUALITY CONTROL

- A. Submit proposed mix design of each class of mix for review prior to beginning of Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- B. Verify compacted subbase is dry and ready to support paving and imposed loads.
 - 1. Prepare subbase in accordance with Section 350 of PennDOT Publication 408
 - 2. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23 – Fill.
- C. Verify gradients and elevations of base are correct.
- D. Verify gutter drainage grilles and frames and manhole frames are installed in correct position and elevation.

3.2 SUBBASE

- A. Prepare subbase in accordance with Section 350 PennDOT Publication 408 standards.

3.3 EXISTING WORK

- A. Saw cut and notch existing paving.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 TACK COAT

- A. Apply tack coat in accordance with PennDOT Publication 408 standards, Section 460.
- B. Apply tack coat to contact surfaces of curbs and gutters.
- C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

3.5 SINGLE COURSE ASPHALT PAVING

- A. Install Work in accordance with PennDOT Publication 408 standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place asphalt wearing course to thickness indicated on Drawings.
- D. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.

- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
- F. Finished work shall be of same quality and appearance as existing asphalt.
- G. All asphalt constructed and replaced shall be installed to like new conditions. Infra-red paving may be required to meet the joints of the sawcut asphalt as determined in the field by the Owner's representative. There shall be no additional cost for this type of construction.

3.6 ERECTION TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation from Indicated Elevation: Within 1/2 inch.

3.7 FIELD QUALITY CONTROL

- A. Install work in accordance with PennDOT Publication 408 standards.

3.8 PROTECTION OF FINISHED WORK

- A. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Aggregate subbase.
2. Concrete paving for:
 - a. Concrete sidewalks and pads.
 - b. Concrete stair steps.
 - c. Concrete curbs.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Preparation of site for paving and base.
2. Section 31 23 23 - Fill: Compacted subbase for paving.
3. Section 32 11 23 - Aggregate Base Courses.
4. Section 32 12 16 - Asphalt Paving.
5. Section 32 91 19 - Landscape Grading: Preparation of subsoil at pavement perimeter.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT - NOT USED

1.4 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. ASTM International:

1. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A185/A185M - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A497/A497M - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

5. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
7. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
8. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
9. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
10. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
11. ASTM C33 - Standard Specification for Concrete Aggregates.
12. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
14. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
15. ASTM C150 - Standard Specification for Portland Cement.
16. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
17. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
18. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
19. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
20. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
21. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
22. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
23. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
24. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
25. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
26. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
27. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
28. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
29. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
30. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
31. ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
32. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
33. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
34. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
35. ASTM E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
36. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
37. ASTM E1918 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.

- 38. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. PennDOT Publication 72M, RC Standards, current edition.

E. PennDOT Publication 408, current edition.

1.5 PERFORMANCE REQUIREMENTS – NOT USED

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

- 1. Submit data on concrete materials, joint filler, admixtures, curing compounds.

C. Design Data:

- 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
- 2. Identify mix ingredients and proportions, including admixtures.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and requirements of Section 03 30 00 – Cast-in-Place Concrete.
- B. Obtain cementitious materials from same source throughout.
- C. Perform Work in accordance with PennDOT Publication 408 standards.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years' experience.

1.9 MOCKUP – NOT USED

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not place concrete when base surface temperature is less than 40 degrees F, surface is wet or frozen, or outside of the paving dates listed in PennDOT Publication 408 unless approved by the Owner's Representative.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Form Materials: Conform to ACI 301. Use flexible or curved forms for curves with a radius of 100 feet or less.
- B. Form Release Agent: Commercially formulated form-release agent with a maximum of 350 g/L volatile organic compound (VOC's) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- C. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/2 inch thick.

2.2 REINFORCING

- A. Reinforcing Steel and Wire Fabric: ASTM A 615, Grade 60; deformed
- B. Welded Plain Wire Fabric: ASTM A185/A185M; in flat sheets.

2.3 CONCRETE MATERIALS

- A. Concrete Materials: As specified in Section 03 30 00 – Cast-in-Place Concrete. Provide in accordance with PennDOT Publication 408 standards.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: ASTM C94/C94M; potable, not detrimental to concrete.
- D. Air Entrainment: ASTM C260.
- E. Chemical Admixture: ASTM C494/C494M.
 - 1. Type A - Water Reducing.
 - 2. Type B - Retarding.

2.4 ACCESSORIES

- A. Curing Compound: Per PennDOT Publication 408 standards.
- B. Joint Sealers: Per PennDOT Publication 408 standards.
- C. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.5 CONCRETE MIX - BY PERFORMANCE CRITERIA

- A. Mix and deliver concrete in accordance with PennDOT Publication 408.
- B. Select proportions for normal weight concrete in accordance with ACI 301 Method 1.
- C. Provide concrete to the following criteria:

1. Compressive Strength: 4,500 psi at 28 days or per plans.
 2. Slump: 1 to 3 inches. Slump limit for concrete containing high-range water reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site verified 2-3 inch slump concrete.
 3. Maximum Water/Cement Ratio: .045
 4. Air Entrainment: ASTM C94/C94M; for moderate exposure condition; maximum variation of 1.5 percent from required air content.
- D. Use accelerating admixtures in cold weather only when approved by the Owner's Representative in writing. Use of admixtures will not relax cold weather placement requirements.
- E. Use calcium chloride only when approved by the Owner's Representative in writing.
- F. Use set retarding admixtures during hot weather only when approved by the Owner's Representative in writing.

2.6 CONCRETE MIX - BY PRESCRIPTIVE CRITERIA- NOT USED

2.7 SOURCE QUALITY CONTROL AND TESTS

- A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services:
- B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of Work.
- C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.
- D. Test samples in accordance with PennDOT Publication 408

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is dry and ready to support paving and imposed loads.
1. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23 – Fill.
- B. Verify gradients and elevations of base are correct.

3.2 SUBBASE

- A. Aggregate Subbase: Install as specified in Section 32 11 23 – Fill.
- B. Prepare subbase in accordance with PennDOT Publication 408 standards.

3.3 PREPARATION

- A. Moisten substrate to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete paving.
- C. Notify Owner's Representative minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

- A. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

3.5 REINFORCING

- A. Place reinforcing as indicated on Drawings.
- B. Interrupt reinforcing at contraction or expansion joints.

3.6 PLACING CONCRETE

- A. Place concrete in accordance with PennDOT Publication 408 standards.
- B. Ensure reinforcing, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.7 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints. Continue steel across joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated. Use bonding agent at butt joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Isolation Joints: Form isolation joints or preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at 20 foot intervals. Align curb, gutter, and sidewalk joints.
 - 2. Extend joint fillers full width and depth of joint
 - 3. Place top of joint filler flush with concrete surface if joint sealant is not indicated.

4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint filler sections together.
 5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, if permitted, as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8" wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction joints. Unless otherwise shown, place joints not to exceed 25 square feet. In curbs, place joints at 10 foot on centers.
- E. Provide keyed joints as indicated.

3.8 FINISHING

- A. Sidewalk Paving: Light broom, radius to 3/4-inch radius, and trowel joint edges. Wood float.
- B. Curbs and Gutters: Light broom.
- C. Direction of Texturing: Transverse to paving direction.
- D. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8" radius; 3/4" at curbs. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.9 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces in accordance with PennDOT Publication 408 standards.

3.10 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- C. Thickness: Plus 3/8", minus 1/4"
- D. Contraction Joint Depth: Plus 1/4", no minus.
- E. Joint Width: Plus 1/8", no minus
- F. Maximum Variation From True Position: 1/4 inch.

- G. ADA surfaces, zero tolerance for minimum and maximum requirements

3.11 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing.
- C. Additional tests will be made when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Any concrete that test results indicate that it does not comply with specified requirements shall be removed and replaced.
- D. All costs for retesting and inspections performed to determine compliance of replaced or additional work shall be borne by the Contractor.

3.12 PROTECTION

- A. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over paving for 14 days minimum after finishing. Until 75 percent design strength of concrete has been achieved.
- C. Maintain concrete pavement free from stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than 2 days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
1. Traffic lines and markings.
 2. Legends.
 3. Paint.
 4. Glass beads.
- B. Related Sections:
1. Section 32 12 16 - Asphalt Paving.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO M247 - Standard Specification for Glass Beads Used in Traffic Paint.
- B. ASTM International:
1. ASTM D34 - Standard Guide for Chemical Analysis of White Pigments.
 2. ASTM D126 - Standard Test Methods for Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate and Chromium Oxide Green.
 3. ASTM D562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer.
 4. ASTM D711 - Standard Test Method for No-Pick-Up Time of Traffic Paint.
 5. ASTM D713 - Standard Practice for Conducting Road Service Tests on Fluid Traffic Marking Materials.
 6. ASTM D969 - Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint.
 7. ASTM D1301 - Standard Test Methods for Chemical Analysis of White Lead Pigments.
 8. ASTM D1394 - Standard Test Methods for Chemical Analysis of White Titanium Pigments.
 9. ASTM D1475 - Standard test Method for Density of Liquid Coatings, Inks, and Related Products.
 10. ASTM D1640 - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.
 11. ASTM D2202 - Standard Test Method for Slump of Sealants.
 12. ASTM D2371 - Standard Test Method for Pigment Content of Solvent-Reducible Paints.

13. ASTM D2621 - Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints.
14. ASTM D2743 - Standard Practices for Uniformity of Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography.

C. PennDOT Publication 408, current edition.

D. PennDOT Publication 35 (Bulletin 15).

1.5 PERFORMANCE REQUIREMENTS

- A. Paint Adhesion: Adhere to road surface forming smooth continuous film one minute after application.
- B. Paint Drying: Tack free by touch so as not to require coning or other traffic control devices to prevent transfer by vehicle tires within two minutes after application.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit paint formulation for each type of paint.
- C. Test Reports: Submit source and acceptance test results in accordance with AASHTO M247.
- D. Manufacturer's Installation Instructions: Submit instructions for application temperatures, eradication requirements, application rate, line thickness, type of glass beads, bead embedment and bead application rate, and any other data on proper installation.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with PennDOT Publication 408 standards.

1.8 QUALIFICATIONS

- A. Applicator: Company specializing in performing work of this section with minimum 5 years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Invert containers several days prior to use when paint has been stored more than 2 months. Minimize exposure to air when transferring paint. Seal drums and tanks when not in use.
- C. Glass Beads. Store glass beads in cool, dry place. Protect from contamination by foreign substances.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Do not apply paint when temperatures are expected to fall below 50 degrees F for 24 hours after application.
- E. Volatile Organic Content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

1.11 WARRANTY

- A. Furnish three-year manufacturer's warranty for traffic paints.

1.12 MAINTENANCE SERVICE

- A. Verify manufacturer's requirements.

PART 2 - PRODUCTS

2.1 PAINTED PAVEMENT MARKINGS

- A. Furnish materials in accordance with PennDOT Publication 408 standards, and PennDOT Bulletin 15.
- B. Paint: In accordance with Section 962 of PennDOT Publication 408. Parking Areas: White, Type I, as specified as shown on the Drawings;

2.2 EQUIPMENT

- A. For application of crosswalks, intersections, stop lines, legends and other miscellaneous items by walk behind strippers, hand spray or stencil trucks, apply with equipment meeting requirements of this section. Do not use hand brushes or rollers. Optionally apply glass beads by hand.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not apply paint to concrete surfaces until concrete has cured for 28 days.

3.2 PREPARATION

- A. Maintenance and Protection of Traffic:
 - 1. Provide short term traffic control in accordance with Section 01 50 00 - Temporary Facilities and Controls.
 - 2. Prevent interference with marking operations and to prevent traffic on newly applied markings before markings dry.
 - 3. Maintain travel lanes between 7:00 AM to 9:00 AM, and between 4:00 PM and 6:00 PM.

B. Surface Preparation.

1. Clean and dry paved surface prior to painting.
2. Blow or sweep surface free of dirt, debris, oil, grease, or gasoline.

3.3 EXISTING WORK

A. Remove existing markings in an acceptable manner. Do not remove existing pavement markings by painting over with blank paint. Remove by methods that will cause least damage to pavement structure or pavement surface. Satisfactorily repair any pavement or surface damage caused by removal methods.

B. Clean and repair existing lines and legends.

3.4 APPLICATION

A. Install Work in accordance with Section 962 PennDOT Publication 408 standards.

B. Apply paint with mechanical equipment to produce uniform straight edges. Apply in a wet film thickness of 15 mils.

C. Glass Bead application rate: 8 to 10 lbs per 100 s.f.

3.5 APPLICATION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Wet Film Thickness: 1 mil.

C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8 inch.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.

C. Repair lines and markings, which after application and curing do not meet following criteria:

1. Incorrect Location: Remove and replace incorrectly placed patterns.
2. Insufficient Thickness, Line Width, Paint Coverage, Glass Bead Coverage or Retention: Prepare defective material by acceptably grinding or blast cleaning to remove substantial amount of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.
3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface one foot beyond affected area. Apply new markings on cleaned surface in accordance with this Section.

D. Replace defective pavement markings as specified throughout 3 year warranted period. Replace markings damaged by anti-skid materials, studded tires, tire chains, chemical deicers, snow plowing or other loss of marking material regardless of cause. When markings

are damaged by pavement failure or by Owner's painting, crack sealing, or pavement repair operations, Contractor is released from warranty requirements for damaged work.

- E. Prepare list of defective areas and areas requiring additional inspection and evaluation to decide where material may need replaced. Provide traffic control as necessary if markings require more detailed evaluation.
- F. Replace pavement marking material under warranty using original or better type material. Continue warranty to end of original 3 year period even when replacement materials have been installed as specified.
- G. When eradication of existing paint lines is necessary, eradicate by shot blast or water blast method. Do not gouge or groove pavement more than 1/16 inch during removal. Limit area of removal to area of marking plus 1 inch on all sides. Prevent damage to transverse and longitudinal joint sealers, and repair any damage according to requirements in Section 32 14 16 – Brick Paving, Section 32 13 13 – Concrete Paving, or Section 32 12 16 – Asphalt Paving.

3.7 PROTECTION OF FINISHED WORK

- A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free. Follow manufacturer's recommendations or use minimum of 30 minutes. Consider barrier cones as satisfactory protection for materials requiring more than 2 minutes dry time.

END OF SECTION 32 17 23

SECTION 32 28 70 –SHELTERS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Picnic Shelter.
 - 2. Bike Shelter.
- B. Contractor shall refer to Shop Drawings provided by the Manufacturer for installation details and instructions.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. The Manufacturer shall include construction details, material descriptions, dimensions of individual components and profiles, finishes, field-assembly requirements, and installation details.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Picnic Shelter: Icon Systems Open Air Steel Hexagon Pavilion. Model #HX32-9M-P4 with 24 gauge pre-cut multi-rib Kynar coated steel roof panels, E- coated frame. Manufacturer: Icon Shelter Systems Inc. 7900 Logistic Drive Suite ‘C’, Zeeland MI, 49464, 800-748-0985. Local Supplier: Jeffrey Associates, 897 Route 910, Indianola, PA 15051, 800-221-8995.
- B. Bike Shelter: Icon Systems Bike Shelter. Model #MC7.5X24M-P3 with 24 gauge pre-cut multi-rib Kynar coated steel roof panels, E- coated frame. Manufacturer: Icon Shelter Systems Inc. 7900 Logistic Drive Suite ‘C’, Zeeland MI, 49464, 800-748-0985. Local Supplier: Jeffrey Associates, 897 Route 910, Indianola, PA 15051, 800-221-8995.

- C. Concrete Footings: Comply with requirements to produce normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum size aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Install Picnic Shelter and Bike Shelter level, plumb, true, at location indicated on Drawings.
- C. Post Setting: Form or auger holes for installing posts in concrete to depth recommended in writing by manufacturer. Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

3.3 CLEANING

- A. After completing Picnic Shelter and Bike Shelter installation, inspect components. Remove spots, dirt, and debris. Repair damage to match original finish or replace component.

END OF SECTION 32 28 70

SECTION 32 31 00 – ORNAMENTAL FENCE

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, finishes of components, installation and operational clearances, gate swings, and details of post anchorage and attachment and bracing.

1.2 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain fences and gates as complete units, including necessary erection accessories, fittings, and fastenings from a single source or manufacturer.
- B. Submit 20 year written warranty against rust and corrosion to Owner covering all fabricated fence products supplied under this section.
- C. Install fencing where shown on drawings or as otherwise directed. Fencing shall be a complete and fully operational installation.

PART 2 - PRODUCTS

2.1 FENCE AND GATES

- A. Fence: Ameristar ‘Echelon Plus’ Commercial Ornamental Aluminum fence (or approved equal) 3-rail design, 6 foot height, with ‘Classic’ top option as indicated on the Drawings. Color: Black.
- B. Gates shall be fabricated using ‘Echelon Plus’ Commercial Ornamental Aluminum fence (or approved equal) 3-rail design, 6 foot height, with ‘Classic’ top option

2.2 MATERIALS

A. Fence and Accessories

1. Height shall be 6 ft. as indicated on the Drawings.
2. Aluminum material for fence framework (i.e., tubular pickets, rails and posts) shall conform to the requirements of ASTM B221. The aluminum extrusions for posts and rails shall be Alloy and Temper Designation 6005-T5. The aluminum extrusions for pickets shall be Alloy and Temper Designation 6063-T52.
3. Pickets shall be 3/4" square x .045" thick. Horizontal rails shall be 1-1/4" x 1-7/16" Forerunner™ profile with .090" top wall, .060" internal web, and .110" side walls. Forerunner rails shall be punched to accept pickets. The rail shall be constructed with an internal web providing a raceway for the pickets to be retained with a 1/8" retaining rod. The number of rails shall vary with the style, height and strength as determined by manufacturer. Fence posts and gate posts shall meet the minimum size requirements of Table 1.
4. Accessories: Aluminum castings shall be used for all post caps, scrolls, finials, and other miscellaneous hardware. Hinges and latches shall be fabricated from aluminum, stainless steel or composite materials.
5. Pickets, rails and posts shall be pre-cut to specified lengths. ForeRunner rails shall be pre-punched to accept pickets. Grommets shall be inserted into the pre-punched holes in the rails and pickets shall be inserted through the grommets so that pre-drilled picket holes align with the internal upper raceway of the ForeRunner rails (Note: This can best be accomplished by using an alignment template). Retaining rods shall be inserted into each ForeRunner rail so that they pass through the pre-drilled holes in each picket, thus completing the panel assembly. Panels without rings shall be biasable up to a 12% change in grade.
6. The manufactured framework shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.
7. Finish: All fence components shall be subject to a six-stage pretreatment/wash followed by an electrostatic spray application of a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2-4 mils. The color shall be black.
8. Classic styles with 3-rail configuration panel styles shall meet IBC compliance. Panel, post and bracket assemblies shall be subjected to structural performance testing according to Chapter 17 – Structural Tests and Special Inspections – International Building Code (IBC) 2018. Physical testing to be completed by accredited third party testing facility. Completed assembly shall demonstrate loading capacity of 2.5 times prescribed design loads found in section 1607.8.1, 1607.8.1.1 and 1607.8.1.2 of IBC 2018 for Handrails and Guards. IBC compliant fence system requirements detailed within Table 4.
9. Swing gates shall be fabricated using 1-1/4" x 1-7/16" Forerunner rail, 1.75" sq. x .125" gate ends, and 3/4" sq. x .080 pickets. Gates that exceed 6' in width will have a 1.75" sq. x .125" intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.
10. Provide gate hinges with 'soft closure' option.

11. Install 'panic bar' gate opener on inside face of gates. All gate hardware shall be ADA (2010 Edition) compliant.
12. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Commercial weight fences under ASTM F2408.
13. Concrete Footings: Mixture to achieve minimum compression of 3000 p.s.i. at 28 days.

PART 3 - EXECUTION

3.1 LAYOUT

- A. The Contractor shall stake the proposed location of the ornamental fence for approval by the Owner and the Landscape Architect prior to installation. Make minor adjustments to avoid obstacles such as trees, large shrubs, storm inlets, utility boxes, walls and existing paving.

3.2 GRADING

- A. The ground shall be graded to an even slope along the length of the area where the fence is to be installed. Install the fence along the specified area. The fence shall be installed a minimum distance of 1" and maximum of 4" above the ground surface. Rake fence panels as required to comply with minimum and maximum specified distance above the ground surface. Adjust fence layout and/or grading as required to avoid abrupt changes in fence elevations.
- B. Post holes shall be a minimum of 12 in. diameter and 36 in. depth.

3.3 FENCE AND GATE INSTALLATION

- A. Fence posts shall be spaced according to manufacturers instructions, plus or minus ¼". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footings having a minimum depth of 36".
- B. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.
- C. The Contractor shall stake the proposed location of the gates for approval by the Owner and the Landscape Architect prior to installation. Make minor adjustments to avoid existing plant material. Center gates on existing or proposed walks and perpendicular to existing or proposed walks. Install gate posts in accordance with manufacturer's instructions.

- D. Concrete Set Gate Posts: Dig holes in firm, undisturbed or compacted soil. Holes shall be as indicated on Drawings. Excavate deeper as required for adequate support in soft and loose soils and for posts with heavy lateral loads. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope to direct water away from posts. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- E. Install gates perfectly horizontal and leveled.
- F. Attach hardware by means which will prevent unauthorized removal.
- G. Adjust hardware for smooth operation.
- H. Keep all nuts outside the fence.

END OF SECTION 32 31 00

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Chain link fence, gates, and accessories.

1.2 RELATED REQUIREMENTS

- A. Temporary Construction Fence: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Fence Color: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Grounding: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. PennDOT Publication 408, current edition.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Installation instructions.
- D. Certificates: Certify products comply with specifications.
 - 1. Fence alignment.
 - 2. Zinc-coating.
- E. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer.
 - 2. Installer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
- B. Installer Qualifications:
 - 1. Regularly installs specified products.

2. Installed specified products with satisfactory service on five similar installations for minimum five years.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Protect products from damage during handling and construction operations.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide fences and gates from one manufacturer.

2.2 CHAIN-LINK FENCING AND GATES

- A. Chain link fence and gates shall be Type 1 as specified in PADOT Publication 408, Section 624 – Right-Of-Way, and as shown on Standard Drawing RC 60M – Right-of-Way Fence.
- B. Confirm PADOT specifications to applicable sections of local municipal ordinances or requirements.

2.3 FINISHES

- A. Finish exposed surfaces after fabrication.
- B. Color Options shall be provided to Owner for selection of Color.
- C. Aluminum Anodized Finish: NAAMM AMP 500.
 1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
 2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Remove existing fences and gates to permit new installation.
 1. Dispose of removed materials.

- D. Apply barrier coating to steel and aluminum surfaces in contact with dissimilar metals and cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION

- A. Layout fence and locate position of post.
- B. Execute work as specified in PADOT 408, Section 624.3 Construction.

3.3 CLEANING

- A. Clean exposed fence surfaces. Remove contaminants and stains.

3.4 PROTECTION

- A. Protect fence from traffic and construction operations.
- B. Repair damage.

END OF SECTION 32 31 13

SECTION 32 33 00 – SITE FURNISHINGS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Benches
 - 2. Dining Tables
 - 3. Dual Recycle/Litter Receptacle
 - 4. Bike Rack
 - 5. Planters
 - 6. Group Grill
 - 7. Accessible Grill
 - 8. Pavilion
 - 9. Covered Bike Shelter

1.3 SUBMITTALS

- A. Product Data: For each product indicated including product literature and manufacturer’s installation details of all site furnishings listed.

PART 2 - PRODUCTS

2.1 SITE FURNISHINGS

- A. F-01 BACKED BENCH
 - 1. Manufacturer: Keystone Ridge Designs.
 - 2. Model: 6’ Bessemer Bench with back.
 - 3. Color: Gloss Black Powdercoat
 - 4. Attachment: surface mount, requires stainless steel anchor bolts (not provided).
 - 5. Quantity: (9)
- B. F-02 DUAL RECYCLE/LITTER RECEPTACLE
 - 1. Manufacturer: Keystone Ridge Designs.
 - 2. Model: Harmony Dual Litter/Recycle Receptacle, 32 gallon with elevated lids and plastic liners.

3. Color: Gloss Black Powdercoat
 4. Attachment: surface mount, requires stainless steel anchor bolts (not provided).
 5. Quantity: (6)
- C. F-03 BIKE RACK
1. Manufacturer: Keystone Ridge Designs.
 2. Model: Sonance 9-bike capacity bike rack
 3. Color: Gloss Black Powdercoat
 4. Attachment: embed mount. Requires subsurface concrete footing per manufacturer's specifications.
 5. Quantity: (3)
- D. F-04 SQUARE RAISED PLANTER
1. Manufacturer: Tournesol Site Works
 2. Model: Wilshire Square FRP fiberglass planter, 36"x36" x 30" height without toe kick, Model #WR-3600F, Smooth finish with standard drain holes (DHC).
 3. Color: Color palette to be provided for Architect/Owner selection.
 4. Attachment: surface mount. Requires corrosion-resistant anchors (not provided).
 5. Quantity: (4)
- E. F-05 4-SEAT DINING TABLE
1. Manufacturer: Keystone Ridge Designs.
 2. Model: Easton 40" diameter round table with umbrella hole and (4) seats with back, perforated table top.
 3. Color: Gloss Black Powdercoat
 4. Attachment: surface mount, requires stainless steel anchor bolts (not provided).
 5. Quantity: (2)
- F. F-06 5-SEAT DINING TABLE (ADA ACCESSIBLE)
1. Manufacturer: Keystone Ridge Designs.
 2. Model: Easton 60" diameter round table with umbrella hole and (5) seats with back, and (1) ADA opening, perforated table top,
 3. Color: Gloss Black Powdercoat
 4. Attachment: surface mount, requires stainless steel anchor bolts (not provided).
 5. Quantity: (3)
- G. F-07 GROUP GRILL
1. Manufacturer: Playworld Systems.
 2. Model: Pedestal group grill, steel
 3. Color: Black enamel finish.
 4. Attachment: surface mount, mount to paving per manufacturers specifications, requires stainless steel anchor bolts (not provided).
 5. Quantity: (1)
- H. F-08 RECTANGULAR RAISED PLANTER
1. Manufacturer: Tournesol Site Works
 2. Model: Wilshire Rectangular FRP fiberglass planter, 120"x18" x 30" height, Model #WR-1201830, Smooth finish with standard drain holes (DHC).

3. Color: Color palette to be provided for Architect/Owner selection.
 4. Attachment: surface mount. Requires corrosion-resistant anchors (not provided).
 5. Quantity: (4)
- I. F-09 3-SEAT DINING TABLE (ADA ACCESSIBLE)
1. Manufacturer: Keystone Ridge Designs.
 2. Model: Easton 40" diameter round table with umbrella hole and (3) seats with back, and (1) ADA opening, perforated table top,
 3. Color: Gloss Black Powdercoat
 4. Attachment: surface mount, requires stainless steel anchor bolts (not provided).
 5. Quantity: (1)
- G. F-10 ACCESSIBLE GRILL
1. Manufacturer: Pilot Rock.
 2. Model: Accessible Park Grill, Model #ASW-20 B18 S6 with 8"x16" swivel shelf attached on base post.
 3. Color: heat-resistant black enamel paint.
 4. Attachment: surface mount with bolt-down base plate, requires stainless steel anchor bolts (not provided).
 5. Quantity: (1)
- H. F-11 PAVILION
1. Manufacturer: Icon Shelter Systems Inc.
 2. Model: Open Air Hexagon Pavilion Structure Model #HX32-9M-P4.
 3. Color: Color palette to be provided for Architect/Owner selection.
 4. Attachment: Embed mount, requires subsurface concrete footing per manufacturers specifications.
 5. Quantity: (1)
- I. F-12 COVERED BIKE SHELTER
1. Manufacturer: Icon Shelter Systems Inc.
 2. Model: Monoslope Bike Shelter, Model #MC7.5X24M-P3.
 3. Color: Color palette to be provided for Architect/Owner selection.
 4. Attachment: Embed mount, requires subsurface concrete footing per manufacturers specifications.
 5. Quantity: (1)
- I. MANUFACTURERS:
1. Keystone Ridge Designs Inc., Local Contact: Adam Benjamin, Territory Manager, Keystone Ridge Designs, Inc. 670 Mercer Rd. Butler, PA 16001-1840. Phone: (724) 284-1213 Ext. 240. Email: Adamb@KeystoneRidgeDesigns.com.
 2. ICON Shelter Systems Inc. Local Contact: Jeffrey Associates, 897 Route 910, Indianola, PA 15051. Phone: 1-800-221-8995. Email: Chris@JeffreyAssociates.com.
 3. Pilot Rock Inc. www.PilotRock.com. Local Contact: Jeffrey Associates, 897 Route 910, Indianola, PA 15051. Phone: 1-800-221-8995. Email: Chris@JeffreyAssociates.com.
 4. Playworld Systems Inc. Local Contact: Jeffrey Associates, 897 Route 910, Indianola, PA 15051. Phone: 1-800-221-8995. Email: Chris@JeffreyAssociates.com.
 5. Tournesol SiteWorks Inc. www.Tournesol.com. Local Contact: Heather Huffer, Tournesol SiteWorks. Phone: (800)542-2282. Email: HHuffer@Tournesol.com.

2.2 MATERIALS

- A. Anchors, Fasteners, Fittings, and Hardware: Commercial quality; tamperproof, vandal and theft resistant; concealed, recessed, and capped or plugged. Provide as required for site and street furnishings' assembly, mounting, and secure attachment.
 - 1. Material: Manufacturer's standard, corrosion-resistant-coated or non-corrodible materials.
 - 2. Angle Anchors: For inconspicuously bolting legs of site and street furnishings to on-grade substrate.
 - 3. Anti-theft Hold-Down Brackets: For securing site furnishings to substrate.
- B. Non-shrink, Nonmetallic Grout: ASTM C 1107 for exterior applications.
- C. Erosion-Resistant Anchoring Cement: Factory-packaged formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended for exterior applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete field assembly of site furnishings.
- B. Install site furnishings level, plumb, true, securely anchored and positioned at locations indicated on Drawings. Final locations of proposed site furnishings shall be field verified and approved by Landscape Architect prior to installation. Show recorded measurements on final As-Built Drawings.
- C. Install site furnishings according to the manufacturer's recommendations.

END OF SECTION 32 33 00

SECTION 32 84 00 – PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. General Description Includes:

1. Underground irrigation system.
2. Sprinklers, drip tubing, and accessories.
3. Pipe and fittings.
4. Automatic control system.
5. Excavation and backfilling for installation of underground system.
6. All necessary permits, licenses and fees.

1.2 SYSTEM DESCRIPTION

A. Layout design:

1. Full and complete coverage is a requirement. Contractor shall, at no additional costs to the Owner, modify layout or make necessary adjustments as needed to obtain full coverage in all areas without overthrow on roadways, pavements, structures, furniture, fountains or buildings and to protect trees and shrubs from close high spray velocity.
2. Provide irrigation layout with separate plant type zones:
 - a. Lawn (seed and sod)
 - b. Plant Beds containing Groundcover, Perennials, Shrubs and/or Trees
3. Provide flow velocities that do not exceed 5.0 ft. per second.
4. Provide irrigation of lawn areas with no overspray into planting beds or pavements, unless so designed on the drawings.
5. Provide independent irrigation of individual bed zones or planters.

B. Only similar types of heads with matched precipitation rates may run on same zone.

C. Piping Design: Do not mix different heads for each line. Provide main size as needed for proper flow, but not less than specified on plan.

D. Provide electric solenoid controlled underground irrigation system manufactured especially for control of automatic circuit valves of underground irrigation system. Provide unit of capacity to suit number of circuits indicated.

1. Source Power: 120 volts AC.
2. Low Voltage Controls: 24 volts AC.

E. Provide controller to control all zones.

F. The extent of the irrigation system is shown on the Drawings.

1.3 SUBMITTALS - REVIEW

A. Product Data: Submit manufacturer's technical data and installation instructions for all components and equipment used.

B. Shop Drawings:

1. Indicate piping layout to water source.

2. Include piping layout and details illustrating location and types of sprinkler heads, valves, control system and wiring diagram showing routes, wire sizes, wiring details and source of current and connections, and schedule of fittings.
 3. Indicate location of sleeves under pavements and conflicts with existing utilities.
- 1.4 SUBMITTALS - CLOSE-OUT
- A. Comply with the requirements of the General Conditions.
 - B. Record Drawings:
 1. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared.
 2. Provide one chart per controller showing the area covered by each satellite controller. The chart shall be a reduced drawing of the actual "as-built" system. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door. A second full-sized copy of each chart is to be given to the Landscape Architect.
 3. The chart shall be a photographically reproduced print with a different color used to show coverage for each station. When completed and approved, the chart shall be hermetically sealed between two pieces of clear plastic. Charts must be completed and approved prior to final inspection of the irrigation system.
 4. At the time of the irrigation mainline test, provide a preliminary set of "Record" drawings to the Owner.
 - C. Operation and Maintenance Data:
 1. Provide schedule indicating length of time each valve is required to be run to provide a determined amount of water.
 2. Include complete parts list with manufacturer's designations for each component.
 - D. Loose Equipment to Furnish: Loose irrigation equipment, operating keys and spare parts will be furnished by the Irrigation Contractor in quantities below:
 1. Two (2) quick coupler keys and matching swivel hose ells for ¾" garden hose.
 2. Two (2) keys for each controller.
- 1.5 QUALITY ASSURANCE
- A. Installer's Qualifications: Single firm specializing in irrigation work with a minimum of five years of experience properly installing irrigation systems of comparable size. Crew leader is to hold a certification of competence in irrigation design or installation.
 1. Provide references of your last five consecutive systems, and five systems of comparable size with bid proposal.
 - B. Multiple units: when two or more units of the same type or class of materials or equipment are required, these units are products of one manufacturer.
 - C. Materials, equipment, and methods of installation shall comply with the following codes and standards:
 1. State of Pennsylvania Building Codes
 2. Pittsburgh Water and Sewer Authority
 3. American Society for Testing and Materials (ASTM)

4. National Sanitation Foundation (NSF)
- D. Nameplates: Nameplate bearing manufacturer's name or identification trademark securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- E. Requirements of Regulatory Agencies:
 1. All work and materials shall be in full accordance with the latest rules and regulations of safety orders of Division of Industrial Safety; the Uniform Building Code and other applicable laws or regulations, including any local Plumbing Codes.
 2. Should the Contract documents be at variance with the rules and regulations, notify the Owner for instructions before proceeding with work affected.
- F. Testing:
 1. Preliminary review of completed main line and wire installation will be made prior to back-filling of trenches and hydrostatic testing.
 2. Final review and testing shall be made in conjunction with the final review of lawn, shrub and tree planting. The irrigation system must be operational for 14 days prior to this final inspection. Any failures are to be corrected and the testing cycle is to be repeated.
 3. Contractor is to notify Landscape Architect three days prior to testing.
- G. Permits and Inspections:
 1. Any permits for the installation or construction of any work included under this contract, which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the contractor, each at the proper time.
 2. The Contractor shall also arrange for and pay all costs in connection with any inspection and examination required by these authorities.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver irrigation system components in manufacturer's original, undamaged and unopened containers, with labels intact and legible.
- B. Deliver plastic pipe in bundles, packaged to provide adequate protection of pipe ends.
- C. Store and handle materials to prevent damage and deterioration.
- D. Provide secure, locked storage for valves, sprinkler heads and similar components that cannot be immediately replaced to prevent installation delays.
- E. Contractor is responsible for materials through final acceptance.

1.7 PROJECT CONDITIONS

- A. Protect existing trees, plants, and lawns and other features designated to remain as part of the final landscape.
- B. The Contractor shall carefully coordinate with the landscape work and other site developments, including all new and existing utilities.
- C. The Contractor shall verify the correctness of all finish grades within the work area to ensure the proper soil coverage of the irrigation pipes.
- D. Irrigation system layout is diagrammatic. Exact location of piping, sprinkler heads, valves, and other components shall be established by Contractor in the field at time of installation.

- E. Where possible sprinkler head layout should match drawings as closely as possible, field stake line and head locations for coordination with landscape contractor and approval by Landscape Architect prior to installation. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. Lines are to be common trenched wherever possible.
- F. Space sprinkler components as indicated. Do not exceed sprinkler spacing shown on Drawings.
- G. Locate existing utilities in areas of work. If utilities are to remain, provide adequate means of protection during the system installation. Repair utilities damaged during the work to the satisfaction of the Utility Owner and at the Contractor's expense. Notify local Utilities Protection Service 48 hours before start of construction.
- H. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, notify the Owner immediately for direction as to procedure. Cooperate with the Owner and Utility companies in keeping active services and facilities in operation.
- I. Minor adjustments in system layout will be permitted to clear existing field obstruction. Final system layout shall be acceptable to the Landscape Architect.

1.8 WARRANTY

- A. Warranties are subject to the General Conditions and Supplementary Agreements.
- B. Irrigation Contractor is responsible to ensure complete coverage as specified herein of the areas to be irrigated. During the warranty period the Irrigation Contractor shall make any adjustments as necessary to maintain proper coverage.
- C. The Contractor shall guarantee all parts and labor for a period of one year from the date of final inspection. If within that period settlement occurs, and adjustments in pipes, valves and sprinkler heads, lawn areas or paving are necessary to bring the system, grade or paving to the proper level of the permanent grades, the Contractor, as part of the work under his Contract, shall make all adjustments without extra cost to the Owner, including the restoration of all damaged planting, paving or other improvements of any kind.

1.9 OPERATION & MAINTENANCE — IRRIGATION SYSTEM

- A. It is the Landscape Contractor's responsibility to determine water application rates and controller cycling. The Irrigation Contractor will coordinate system installation with planting soil placement and planting activities. The Irrigation Contractor will also instruct the Landscape Contractor on the operation and programming of the controller and will assist the Landscape Contractor as necessary in such operations throughout the one-year maintenance period. Any adjustments, repairs, etc., other than programming, are the total responsibility of the Irrigation Contractor.
- B. As part of this contract, the Irrigation Contractor shall winterize the system the first year and provide written instructions to the Owner for future service and maintenance. The Irrigation Contractor shall return to the site during the subsequent spring season and demonstrate to the Owner the proper procedures for the system start-up, operation and maintenance.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyl (PCB) or other hazardous materials identified by the Owner.

2.2 IRRIGATION SYSTEM MANUFACTURERS

- A. All irrigation system components shall be supplied by regionally authorized distributors to provide single source responsibility for warranty service and operations to conform to specifications in all aspects.

2.3 MATERIALS

- A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of this system.
- B. Plastic Pipe
1. All piping shall be from virgin parent material. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, deleterious wrinkles and dents. All pipe shall be National Sanitation Foundation (NSF) approved.
 2. For all mainline piping 3" and over, use SDR 21 Class 200 gasketed PVC bell and spigot pipe.
 3. For all other irrigation piping, use polyvinyl chloride (PVC) 1120 with a minimum class rating of 200, sized to maintain a maximum flow velocity of less than 5 ft. per second (FPS).
 4. Outside diameter of pipe shall be the same as iron pipe.
 5. Pipe shall be marked at intervals (not to exceed 5') with the following information: Manufacturer's name or trademark, nominal pipe size, schedule, PVC type and grade (i.e. PVC 1120), SDR rating class, working pressure at 73 degrees F. and NSF approval.
 6. Caution should be utilized in handling Type I pipe due to the possibility of cracking or splitting when dropped or handled carelessly.
 7. When connection is plastic to metal, male adapters shall be used. The male adapter shall be hand tightened, plus one turn with a strap wrench.
 8. Comply with pipe sizes indicated on drawings. No substitution of smaller pipe will be permitted. Larger sizes may be used subject to acceptance of the Landscape Architect. Remove damaged and defective pipe from site.
 9. All PVC pipe to be furnished in 20' lengths.
 10. Acceptable Manufacturer:
 - a. Silverline Plastics
- C. Piping for Sleeving
1. For sleeves less than six inches in size, use high impact type, polyvinyl chloride (PVC) 1120, minimum Schedule 40.
 2. Sleeves six inches and above in size shall be Polyvinyl Chloride (PVC) 1120 Class 200.
 3. Irrigation Contractor shall be responsible for the coordination of sleeves for all piping passing through concrete curbing, under paved areas, concrete or masonry walls and floors while the same are under construction.
 4. Acceptable Manufacturer:
 - a. Silverline Plastics
- D. PVC Fittings
1. Schedule 40 or 80, polyvinyl chloride (PVC), Type 1 injection molded fittings suitable for solvent weld or threaded connections. Fittings made of other materials are not permitted.
 2. Threaded PVC nipples shall be Schedule 80. Use high quality grade of Teflon tape for threaded fittings.

- (a) Saddle fittings are not permitted.
 - (b) Use high quality grade of Teflon tape for sprinkler head and electric control valve connections.
- 3. Acceptable Manufacturer:
 - a. Spears Manufacturing
- E. Isolation Valves
 - 1. Gate valves under 3" shall be 200 PSI rated W.O.G. 200 domestically manufactured with bronze bodies. Valves shall be equipped with tee handles.
 - 2. The valve shall have a 100% urethane coated wedge insuring a bubble-tight seal up to 200 PSI. The valve shall be fusion-bonded epoxy coated with PVC push-on, threaded or mechanical connections and a two-inch square nut for vertical valve stem key.
 - 3. Acceptable Manufacturer:
 - a. Watts Regulator
- F. Quick Coupling Valves
 - 1. Valve shall be of one-piece construction with a 1" female top thread with vinyl cover.
 - 2. Furnish one valve key fitted with 3/4" swivel hose ends.
 - 3. All quick coupling valve keys and hose swivels shall be of the same manufacturer as the quick coupler.
 - 4. Acceptable Product:
 - a. Rain Bird model 5RC
- G. Valve Boxes
 - 1. Tapered rib reinforcement enclosure of rigid tensile strength plastic material components chemically inert and unaffected by moisture, ultraviolet light, corrosion and temperature changes. Lid and base shall withstand normal loads exerted by turf equipment without collapsing. Box and lid to be black.
 - 2. For remote control valves use rectangular standard turf box, 16" x 10".
 - 3. For Isolation valves and quick coupler valves use 10" circular turf box.
 - 4. Acceptable Manufacturer:
 - a. Rain Bird PVB series
- H. Fixed Sprays
 - 1. Full or part circle pop-up fixed spray sprinkler.
 - 2. The sprinkler body, stem, nozzle and screen shall be constructed of heavy-duty, ultra-violet resistant plastic. It shall have a heavy-duty stainless steel retract spring for positive pop-down and a ratcheting system for easy alignment of the pattern. The sprinkler shall have a soft elastic pressure-activated co-molded wiper seal for cleaning debris from the pop-up stem as it retracts into the case to prevent the sprinkler from sticking up to minimize "flow-by." The sprinkler shall have a matched precipitation rate (MPR) plastic nozzle with an adjusting screw capable of regulating the radius and flow. The sprinkler shall be capable of housing under the nozzle; protective, non-clogging filter screens or pressure compensating screens. The screen shall be used in conjunction with the regulating screw for regulating.
 - 3. The sprinkler shall have a flush plug reinstalled. The plug shall prevent debris from clogging the sprinkler during installation and allow for system to be flushed before nozzling. The plug shall be bright orange in color and constructed of polypropylene material.

4. The 4", 6" or 12" high pop-up spray sprinklers shall also include an integral pressure-regulating device (PRS) if operating pressure is above 65 PSI. These units shall be identifiable from the top by the marking "PRS".
 5. Sprinklers subject to low head drainage shall have integral check valves capable of holding back to 7' of head. Such sprinklers shall be clearly marked with "SAM" on top.
 6. Pop-up heights: 4 inches, 6 inches and 12 inches (see drawings).
 7. Nozzles for sprinkler heads shall be of the same manufacturer as the sprayhood.
 8. Acceptable Product:
 - a. Rain Bird model 1800, 1800SAM, or 1800SAM-P45
- I. Short-Range Rotors
1. The full or part circle rotor sprinkler shall be a single stream, water lubricated, gear drive.
 2. The sprinkler shall have adjustable arc coverage from 40 to 360 degrees in one unit.
 3. The sprinkler shall have a pressure-activated multi-function wiper seal that positively seals against the nozzle flange to keep debris out of the rotor and to clean debris from the pop-up stem as it retracts. The wiper seal shall prevent sprinkler from sticking up and be capable of sealing the sprinkler cap to sprinkler body under normal operating pressures.
 4. The sprinkler shall be fully adjustable from the top using only a flat-blade screwdriver.
 5. The sprinkler shall have a screen attached to the drive housing to filter inlet water, protect the drive from clogging and simplify its removal for cleaning and flushing of the system. It shall have a 3/4" (FNTF) bottom inlet.
 6. The sprinkler shall have a stainless adjusting screw capable of reducing the radius to 25%.
 7. Acceptable Product:
 - a. Rain Bird model 3504PC or 3504FC
- J. Mid-Range Rotors
1. The full or part circle rotor sprinkler shall be a single stream, water lubricated, gear drive.
 2. The part circle sprinkler shall have adjustable arc coverage from 30 to 350 degrees.
 3. The sprinkler shall have a thread-on nozzle assembly whose installation shall not require any tools. The arc adjustment shall not require any tools.
 4. The sprinkler shall have a pressure-activated multi-function wiper seal that positively seals against the nozzle flange to keep debris out of the rotor and to clean debris from the pop-up stem as it retracts. The wiper seal shall prevent sprinkler from sticking up and be capable of sealing the sprinkler cap to sprinkler body under normal operating pressures.
 5. The sprinkler shall have a screen attached to the drive housing to filter inlet water, protect the drive from clogging and simplify its removal for cleaning and flushing of the system. It shall have a 3/4" bottom inlet.
 6. The sprinkler shall have a stainless steel retract spring for positive pop down.
 7. The sprinkler shall have an adjusting screw capable of reducing the radius by up to 25%.
 8. Sprinklers subject to low head drainage shall have integral check valves capable of holding back to 7' of head. Such sprinklers shall be clearly marked with "SAM" on top.
 9. Pop-up heights: 4 inches and 12 inches (see drawings).
 10. Acceptable Products:
 - a. Rain Bird model 5000 or 5000-SAM
- K. Drip Tubing

1. Drip tubing shall be continuously self-flushing and pressure compensating. It shall consist of nominal sized one-half inch low density, linear polyethylene tubing, housing internal pressure compensating, continuously self-flushing, integral drip emitters.
 2. The tubing shall be brown in color and conform to an outside diameter (O.D.) of 0.67 inches, and an inside diameter (I.D.) of 0.57 inches. The emitters shall have the ability to independently regulate discharge rates, with an output pressure of seven to seventy PSI, at a constant flow.
 3. The emitter discharge rate shall be 0.61 gallons per hour (GPH), utilizing a combination turbulent flow/reduced pressure compensation cell mechanism and a diaphragm to maintain uniform discharge rates. The emitters shall continuously clean themselves while in operation. The tubing shall have 18" spacing between emitters as noted on drawing.
 4. Acceptable Product:
 - a. Netafim TLCV6-18
- L. Automatic Controller
1. The controller shall be a full-featured residential and light commercial product for the purpose of irrigation operation, management, and monitoring of control valves and sensors. The controller shall be fully integrated with Wi-Fi connectivity to the internet and Hydrowise irrigation management software.
 2. The controller shall be of a modular design that is provided with a standard 4-station output module. The controller shall be expandable with 3-, 9-, or 16-station modules to a maximum of 23 conventional stations.
 3. The controller shall be furnished in an indoor/outdoor, weather-resistant, wall-mount plastic enclosure, NEMA 3R IP44 rated, suitable for remote control, with a key lock.
 4. Display shall be 2.9", full-color graphical touch screen interface allowing for programming and manual operation. All programming shall be accomplished by use of the touchscreen or with smartphone, tablet, or PC.
 5. Transformer input shall be 120 VAC, 60 Hz or 230 VAC, 50 Hz. Transformer output shall be 24 VAC, 1 A. Maximum output per station (at 24 VAC) shall be up to 0.56 A. Maximum output per P/MV terminal (at 24 VAC) shall be up to 0.28 A.
 6. The controller transformer shall be equipped with an internal, self-resetting thermal circuit breaker to protect against overheating. Each station output shall have metal oxide varistor (MOV) surge protection, supplemented by copper induction coils.
 7. The controller shall have self-diagnostic, electronic short-circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports the faulty station on the display. The diagnostic function shall also be capable of being initiated manually by the user.
 8. The sensor input shall be compatible with any standard normally closed or normally open sensors for automatic shutdown during rain, freeze, soil moisture, and/or wind events.
 9. Controller shall be equipped with built-in Wi-Fi. Operation shall be 802.11 b/g/n protocol.
 10. Wi-Fi frequency is 2.4 GHz only. Security shall have the ability to auto detect and offer the following security settings: WPA2, WPA Personal, and WPA Auto.
 11. The control panel shall be available in an English language display. The display shall include selectable settings for date, time, and units of measure.
 12. Standard programming option allows for 6 independent irrigation programs and 6 Start Times per program. The controller shall be capable of running any one station (+P/MV) at a time. The controller programs shall have 5 weekly schedule options to choose from:

- a. 7-day calendar
 - b. Up to 31-day interval calendar
 - c. Odd-day/even-day programming
 - d. Odd-week/even-week programming
 - e. 365-day calendar clock to accommodate true odd-even watering
13. Each station shall be programmable in minutes of run time, from 1 minute to 24 hours.
14. The controller shall be equipped with programmable Non-Water Days to prevent watering on selected days of the week.
15. The controller shall be connected to Hydrowise software. The controller shall utilize Predictive Watering™ adjustments to automatically modify irrigation scheduling based on local weather data and forecast information.
16. The controller also has Seasonal Adjust settings from 0% to 300% for offline programming.
17. Acceptable Product:
 - a. Hunter HPC
- M. Control Wire
 1. Individual conductors of single strand solid copper wire type, with PVC jacket. UF 600-volt AWG #14 minimum, approved for direct burial. For runs over 2,000 L.F. use AWG #12. Contractor is to verify that wire sizes are within recommended wire run lengths for proper solenoid operation.
- N. Rain Shutoff
 1. One device shall be provided for each controller. Install per manufacturer's latest printed instructions.
 2. Verify with Landscape Architect as to final location of rain shutoff.
 3. Acceptable Product:
 - a. Hunter Mini-Clik
- O. Control Valves (Sprinklers)
 1. The electric control valve shall be a normally closed 24 VAC 50/60 Hz (cycles/sec) solenoid actuated globe/angle pattern design. The valve pressure rating shall not be less than 150 PSI.
 2. The valve body and bonnet shall be constructed of high-impact, water-resistant PVC for the
 3. body and glass-filled nylon for the bonnet with stainless steel screws.
 4. The valve shall have manual open/close control (internal bleed) for manual opening and closing of valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box.
 5. The valve shall house a fully encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing, and a leverage handle for easy turning. This 24-VAC 50/60 Hz solenoid shall open with 19.6 VAC minimum at 150 PSI. At 24 VAC, average inrush current shall not exceed 0.41 amps. Average holding current shall not exceed 0.28 amps.
 6. The valve shall have a flow control stem for accurate manual regulation and/or shut off of outlet flow. The valve must open or close in less than 1 minute at 150PSI and less than 30 seconds at 20 PSI.
 7. The valve construction shall provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. The body shall have a removable O-ringed plug for installation in either globe or angle configuration.
 8. Acceptable Product:

a. Rain Bird model PGA

P. Control Valves (Drip)

1. The control valve shall be normally closed 24-VAC 50/60-cycle solenoid actuated globe pattern. The pressure rating shall not be less than 150 PSI.
2. The valve body and bonnet shall be constructed of UV-resistant plastic and have stainless steel screws; diaphragm shall be of nylon reinforced nitrile rubber.
3. The valve shall have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box.
4. The valve shall house a fully encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing, and a leverage handle for easy turning. This 24-VAC 50/60 Hz solenoid shall open with 19.6-volt minimum at 150 PSI. At 24-VAC, average inrush current shall not exceed .23 amps.
5. The valve construction shall be such as to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
6. The complete valve control kit shall consist of the electric valve, a 200-mesh stainless steel filter screen, and a 30-PSI pressure regulator.
7. See Drawings for size of valves.
8. Acceptable Product:

a. Rain Bird XCZPGA-100-PRF

Q. Accessory materials

1. Drainage fill at valve boxes:
 - a. Provide 1" washed pea gravel in each valve box.
2. Suitable excavated materials removed to accommodate the irrigation system work shall be used as fill materials provided it conforms to the requirements of fill as noted above.

R. PVC Solvent Cement:

1. Provide professional grade cement, Whitlam #PR32 or approved equivalent for PVC pipe and fittings.

S. PVC Primer/Cleaner

1. Provide professional grade primer/cleaner, Whitlam #PP32 or approved equivalent (purple) primer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Lay out work as accurately as possible to Drawings. Drawings are diagrammatic to the extent that swing joints, offsets, and fittings are not shown.
- B. The Irrigation Contractor shall carefully schedule his work with the Landscape Contractor and all other site developments.
- C. Sleeves are required wherever piping or electrical wires are placed under paved surfaces. (Installed as part of other sections and Contract). Irrigation Contractor is responsible for coordination of all sleeves.
- D. Full and completed coverage is required. Contractor shall make any necessary minor adjustments to layout as required to achieve full coverage of irrigated areas at no additional cost to the Owner.

- E. Where piping is shown on drawings to be under paved areas but running parallel and adjacent to planted areas, the intent is to install piping in planted areas. Do not install directly over another line in the same trench.
- F. It shall be the Contractor's responsibility to establish the location of all sprinkler heads in order to assure proper coverage of all areas. In no case shall spacing of sprinkler heads exceed distances shown on the drawings and/or those specified. Pipe sizes shall conform to those shown on drawings. No substitution of smaller pipe sizes will be permitted, but substitutions of larger sizes may be approved. All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection.
- G. Install irrigation system after completion of site grading, the irrigation system shall be installed and completely operational three days prior to the installation of any planting operations.

3.2 POINT OF CONNECTION

- A. Provide irrigation system complete from point of connection provided by Plumber. See Drawings for Point of Connection (POC).

3.3 EXCAVATING

- A. All piping is to be trenched, other than one inch, which may be pulled.
- B. Excavate to depths required to provide six inches of Granular Fill bedding material under paved surfaces.
- C. Should utilities not shown on the plans be found during excavations, the Contractor shall promptly notify the Owner for instructions as to further actions required. Failure to do so will make Contractor liable for all damage thereto arising from his operations subsequent to discovery of such utilities. Indicate such utility crossings on the record drawings promptly.
- D. Install main line irrigation lines with a minimum cover of eighteen inches and a maximum cover of twenty-four inches based on finished grades.
- E. Install lateral irrigation lines with a minimum cover of twelve inches and a maximum cover of twenty-four inches based on finished grades.
- F. Perform all excavations as required for installation of work included under this Section, including shoring of earth banks, if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations, to their original condition.
- G. Trenches shall be open, vertical sided construction wide enough to provide free working space around work installed and to provide adequate space for backfilling and compacting.
- H. When two pipes are to be placed in the same trench, a six-inch space is to be maintained between the pipes. The Contractor shall not install two pipes with one directly above the other.
- I. The Contractor shall cut trenches for pipe to required grade lines and compact trench bottom to provide accurate grade and uniform bearing for the full length of the line.
- J. The Contractor shall be held responsible for damages caused by these operations and shall immediately repair or replace damaged parts.

3.4 PIPELINE ASSEMBLY

- A. General
 - 1. Install pipes and fittings in accordance with manufacturer's latest printed instructions.

2. Clean all pipes and fittings of dirt, scales and moistures before assembly.
 3. All pipe, fittings and valves, etc., shall be carefully placed in the trenches. Interior of pipes shall be kept free from dirt and debris and when laying is not in progress, open ends of pipe shall be closed by approved means.
 4. All lateral connections to the main line as well as all other connections shall be made to the side of the main line pipe. No connections to the top of the line shall be allowed.
- B. Solvent-Welded Joints for PVC Pipe
1. Use solvents and methods approved by solvent and pipe manufacturers.
 2. Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty-four hours before placing the joint under water pressure, unless otherwise specified by the manufacturer. Cut all pipe with square ends and remove burrs, ridges and dirt. Check dry fit pipe and fitting. Clean pipe and fitting with purple primer and apply thin coat of cement to fitting with a liberal coat to pipe. Quickly push pipe fully into fitting using a $\frac{1}{4}$ turning motion. Hold pipe and fitting together a minimum of 30 seconds, wipe off excess with cloth.
- C. Threaded Joints for PVC Pipe
1. Use Teflon tape on all threaded PVC fittings.
 2. Use strap-style friction wrench only. Do not use metal-jawed wrench.
- D. Laying of Pipe
1. Pipes shall be bedded in at least in at least two inches of finely divided material with no rocks or clods over one-inch diameter to provide a uniform bearing.
 2. Pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 feet of pipe is the minimum allowance for snaking.
 3. Do not lay PVC pipe when there is water in the trench.
 4. Plastic pipe shall be cut with PVC pipe cutters or hacksaw, or in a manner to ensure that a square cut. Burrs at end cuts shall be removed prior to installation so that a smooth unobstructed flow will be obtained.
 5. All plastic-to-plastic joints will be solvent-weld joints or slip seal joints. All plastic pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer and it shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. The Contractor shall assume full responsibility for the correct installation.

3.5 PVC SLEEVES AND ELECTRICAL CONDUIT

- A. Provide all sleeves indicated and as otherwise required for the successful completion of the irrigation system. Coordinate sleeving efforts with General Contractor and the Owner.
- B. All PVC sleeves shall be a minimum of twice the diameter of pipe to be sleeved.
- C. All PVC control wire conduit shall be of sufficient size to hold the required quantity of control and common wires. Electrical wires are not to be placed in the same trench with water pipes.

3.6 ISOLATION VALVES

- A. Shall be located in the following locations:
1. After backflow preventer and prior to main supply loop.

2. Between main line and each quick coupler valve.
 3. As located on irrigation system drawings within lawn areas.
- B. Install each isolation valve in an individual valve box with a six-inch (deep) layer of washed gravel below the bottom of the valve.
- C. Seal threaded connections with Teflon tape.

3.7 IRRIGATION CONTROL VALVES

- A. Coordinate location of all valve boxes with Landscape Architect. Do not proceed in uncertainty.
- B. All irrigation control valves shall be installed with ductile iron service tees.
- C. Install line size bronze gate valve on pressure side of each control valve. Locate in valve box with control valve.
- D. Install each electric control valve in an individual valve box with a six-inch (deep) layer of washed gravel below the bottom of the valve.
- E. Seal threaded connections with Teflon tape.
- F. Valves shall be installed as shown in details and in accordance with manufacturer's instructions and specifications.

3.8 QUICK COUPLING VALVES

- A. Shall be set a minimum of twelve inches from walks, curbs, or paved areas where applicable or as otherwise noted. Quick coupling valves shall be housed in standard size valve boxes.
- B. All quick coupler valves shall be installed on to ductile iron service tee.
- C. Install one-inch bronze gate valve on pressure side of each quick coupler valve. Locate in valve box with quick coupler valve.
- D. Valves shall be installed on a three-elbow PVC Schedule 80 swing joint assembly.
- E. Provide six-inch (deep) layer of washed gravel below the bottom of the valve. Top of quick coupler valves shall be as close to the top of the valve box as possible. Top of gravel layer shall be three inches below the top of the valve.
- F. Quick coupling valves shall be set perpendicular to finished grade unless otherwise designated on the plans.
- G. Quick coupler locations are to be staked in the field by installer for approval by Landscape Architect prior to installation.

3.9 VALVE BOXES

- A. Valve boxes shall be set flush with grade in lawn areas and one-half inch above finish grade in ground cover and shrub bed areas.
- B. Install valve access boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the valve box.

3.10 SPRAY HEADS AND ROTORS

- A. All sprinkler heads shall be pop-up type heads. Permanent shrub risers are not permitted.

- B. All sprinkler heads within a zone shall have matched precipitation rates.
- C. Install plumb to within 1/16", unless otherwise noted (see detail for heads on sloped areas on detail sheet). Top of collar (not nozzle) should be flush with finish grade.
- D. Place part-circle pop-up sprinkler heads at least two inches and no more than six inches from edge of adjacent walks, curbs and mowing bands, or paved areas at time of installation.
- E. Install pop-up sprinkler heads, and accessories in accordance with manufacturer's latest printed instructions, except as otherwise noted.
- F. All sprinkler nozzles shall be adjusted for the proper radius and direction of spray pattern. Adjust where possible to prevent over spraying onto walks, pavement or buildings.
- G. Tighten nozzles on spray type sprinklers after installation. Adjust sprinkler adjusting screw as required for proper radius.
- H. Install pop-up spray heads with approved flexible thick wall polyethylene swing pipe with spiral barb fittings. Do not install to side inlet of sprinkler head.
- I. Install pop-up mid-range turf rotors with approved flexible thick wall polyethylene swing pipe with spiral barb fittings.
- J. Install pop-up long-range turf rotors with PVC unitized swing joints with one-piece riser assembly. Swing joints to be factory assembled with 360-degree O-ring seals as manufactured by Lasco. All connections to be threaded, no glued connections shall be allowed on the swing joints.
- K. Polyethylene swing joints are not to be used to extend head more than eighteen inches from lateral.
- L. Heads to be installed at the top of a slope shall be tilted toward the toe of the slope. They shall also be installed slightly down from the top edge of the slope to decrease wind drift.
- M. Mid-slope sprinkler heads shall be installed at an angle halfway between vertical and perpendicular to the slope. For example, a 2:1 or 50% slope has an angle of 26 degrees, so tilt the heads 13 degrees into the slope from the perpendicular.
- N. Heads installed at the toe of the slope shall be tilted slightly away from the slope to avoid driving water into the slope directly in front of the sprinkler.
- O. Do not mix different types of heads within a zone.

3.11 DRIP TUBING

- A. Tubing is designed for use in surface and sub-surface applications utilizing a grid design, the result being a complete wetted area within the grid. It can also be installed as single or "snaked" lines where grids are not justified. The most uniform way to install tubing is sub-surface at a uniform depth as specified.
- B. Tubing shall be staked down using 6" galvanized sod staples. Staples shall be spaced no further than 24" on center, but the contractor will place staples as closely as necessary to ensure that the tubing will not work its way to the surface.

3.12 CONTROLLER

- A. Mount the controller flush with the mounting surface. Controller should be level with the surface of the floor or concrete mounting pad. Install controller with display at eye-level if possible.
- B. Mount the controller pedestal with the mounting hardware and template supplied.

- C. The automatic controller shall be installed at the approximate location shown on the Drawings (suitable power supply will be supplied as part of other sections and Contract).
- D. All local and other applicable codes shall take precedence in connecting the 110-volt electrical service to the controller.
- E. Install per local code, manufacturer's latest printed instructions, and as detailed.
- F. Valve control wires shall be numbered at the terminal strip.

3.13 CONTROLLER POWER SUPPLY

- A. Power to the controller shall be supplied from a dedicated circuit (installed as part of work of other sections and Contract).
- B. The Irrigation Contractor shall be responsible for all wiring and associated equipment to connect power supply to the controller.
- C. All wiring is to be in accordance with local codes.

3.14 CONTROL WIRING

- A. All electrical equipment and wiring shall comply with local and state codes and be installed by those skilled and licensed in the trade.
- B. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines whenever possible and shall have a minimum of twelve inches of cover.
- C. Control wires shall be installed to the side of the main line whenever possible. Placement over pipes is not permitted.
- D. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals of twenty feet.
- E. An expansion curl shall be provided within three feet of each wire connection and at least every one-hundred feet of wire length on runs of more than one hundred feet in length. Expansion curls shall be formed by wrapping at least five turns of wire around a one-inch diameter pipe, then withdrawing pipe.
- F. Control wire splices at remote control valves to be crimped and sealed with specified splicing materials. The connector shall be 3M DBY splice kit by 3M Corporation.

3.15 CLOSING OF PIPE AND FLUSHING OF LINES

- A. All testing shall be done under the supervision of the Landscape Architect and Owner. Submit written requests for inspections to the Owner at least three days prior to the anticipated inspection date.
 - 1. Thoroughly flush out all water lines under a full head of water before installing heads, valves, quick coupler assemblies, etc. Maintain flushing for a minimum of three minutes at the valve located furthest from water supply.
 - 2. After flushing, cap all openings to prevent entrance of materials that would obstruct the pipe or clog heads. Leave in place until removal is necessary for completion of installation.
 - 3. Test as specified below.
 - 4. Upon completion of testing complete assembly and adjust sprinklers for proper distribution.

3.16 TESTING

- A. Make hydrostatic when welded PVC joints have cured as per manufacturer's instructions.
 - 1. Pressurized mainlines:
 - (a) Completely install water meter, mains, isolation valves and control valves.
 - (c) Fill all lines with water and shut off at meter.
 - (d) Test piping at 70 PSIG for one-half hour. Maximum loss shall be five PSI.
 - (e) Install pressure gage shut-off valve and safety blow-off valve between pressure source and piping. Inspect each joint and repair any leaks.
 - (f) Leaks resulting from tests shall be repaired and tests repeated until the system passes.
- B. Non-pressurized laterals:
 - (a) Test piping after laterals are installed and system is fully operational.

3.17 INSPECTIONS

- A. The contractor shall maintain proper facilities and provide safe access for inspection to all work.
- B. Irrigation inspection shall consist of a minimum of:
 - 1. Mainline pressure test.
 - 2. Coverage test.
 - 3. Final irrigation inspection.
- C. If the specifications, the Owner's and/or Landscape Architect's instructions, laws, ordinances or any public authority require any work to be tested or approved, the contractor shall give the Owner 72 hours of notice of its readiness for inspection.
- D. The contractor shall be solely responsible for notifying the Owner and Landscape Architect where and when such work is in readiness or testing.
- E. If any work should be covered up without the approval of the Owner and Landscape Architect it must be uncovered, if required, for examination at the contractor's expense.
- F. No inspection will commence without "Record" drawings and without completing previously corrections, or without preparing the system for inspection.

3.18 BACKFILLING AND COMPACTING

- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches.
 - 1. Restore all surfaces to match adjacent surfaces. Meet grades flush. Create smooth blends and transitions.
- B. Granular fill corresponding with Section Earthwork shall be placed initially on all lines with a minimum of three inches cover. No foreign matter larger than one-half inch in size shall be permitted in the initial backfill.
 - 1. Trenches located under paving shall be backfilled with compacted Granular Fill corresponding with the requirements of Section Planting Soil System (three inches above the pipe).
 - 2. Backfill in lawns and planting beds shall be planting soils corresponding with the requirements of Section Planting Soil System. Coordinate with the Landscape Contractor.
 - 3. Surplus subgrade and planting soils remaining after backfilling shall be legally disposed of off-site by the contractor.

3.19 CLEANING AND DISPOSAL OF WASTE MATERIAL

- A. Perform clean up during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment as fast as it accumulates.
- B. Stockpile, haul from site, and legally dispose of waste materials, including unsuitable excavated materials, rock, trash, and debris.

END OF SECTION 328400

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preparation of subsoil.
 - 2. Soil testing.
 - 3. Placing topsoil.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading: Rough grading of site.
 - 2. Section 31 23 16.13 - Trenching: Rough grading over cut.
 - 3. Section 32 91 19 - Landscape Grading: Preparation of subsoil and placement of topsoil in preparation for the Work of this section.
 - 4. Section 32 92 19 – Seeding.
 - 5. Section 32 93 00 - Plants.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.
- C. Provide certification and test results of compost for landscape restoration to ensure compliance with Conservation District requirements and Drawings.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with PennDOT Publication 408 standards and Drawings.

1.6 COORDINATION

- A. Verify site conditions for the Work are in accordance with the Drawings.
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

1.7

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Topsoil: As specified in Section 31 05 13 – Soils for Earthwork.
- B. Compost: As specified in Section 31 05 13 – Soils for Earthwork.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify prepared soil base is ready to receive the Work of this section.

3.2 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots.
- C. Scarify subsoil to depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 PLACING TOPSOIL

- A. Spread topsoil to minimum depth of 4 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. In areas specified for soil amendments, place in accordance with Section 31 23 23 - Fill.
- D. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- E. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

END OF SECTION 32 91 13

SECTION 32 91 19 – TOPSOIL PLACEMENT AND GRADING**PART 1 – GENERAL****1.1 STIPULATIONS**

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION OF WORK:

- A. The work of this Section consists of preparing and placing topsoil and planting mix on a prepared subgrade. The Contractor shall provide and install all topsoil required for planting beds.

1.3 SUBMITTALS:

- A. The Contractor shall submit soil test analysis report for all planting mix and top soil from an approved soil testing laboratory, which includes the following:
- B. Particle size analysis including the following gradient of mineral content:

<u>Designation:</u>	<u>Size in mm:</u>
Gravel	+ 2 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.1 - 0.25 mm
Very Fine Sand	0.05 - 0.1 mm
Silt	0.002 - 0.05 mm
Clay	minus 0.002 mm

- C. Physical analysis including the following:

- a. pH.
- b. Percent organic content.
- c. Percent moisture retention.
- d. Water permeability in inches per hour.
- e. Bulk density.
- f. Pore space, which is defined as the difference between the saturated weight of the soil and its oven dry weight at the specified compaction.
- g. Large aeration space which is calculated as the difference between the saturated weight of the soil and the weight of the soil at 40 cm. tension at the specified compaction.
- h. Nutrient levels including nitrogen, phosphorus and potassium.
- i. Soluble salt in ppm.

- D. All testing shall be at the expense of the Contractor. Tests shall be performed with the sample compacted to 45 foot pounds at 40 cm. moisture tension where applicable.
- E. Submit one-pound samples of all soils, soil mixed and soil additive products in this Section. Samples should be labeled to include the location of the source of the material.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Do not deliver or place soils in frozen, wet, or muddy condition.

PART 2: PRODUCTS

2.1 TOPSOIL:

- B. Fertile, friable, loamy soil, containing 1 to 5 percent by weight organic matter; free from subsoil, refuse, roots, heavy or stiff clay, clay lumps or stones larger than 1 inch, noxious seeds, sticks, brush, litter, and other deleterious substances; suitable for the germination of seeds and the support of vegetative growth. The pH value shall be between 5.5 and 6.5.
- C. Soil Texture: Loam soil suitable to obtain the following physical analysis results:
 - 1. Percent moisture retention 25% max.
 - 2. Water permeability, 1 inch per hour min.
 - 3. Bulk density, 1.75 gr/cubic cm max.
 - 4. Pore space, 35 percent - 55 percent with 20 percent min. of the pore space to be large aeration spaces.
- D. Provide a minimum of (3) particle analysis tests from samples obtained randomly throughout the source stockpile. Samples of topsoil to be used for planting mix shall be used in developing the mix design.

2.2 FILL MATERIAL:

- A. Fill material shall be inert subsoil material, free of organic matter, rubbish, debris, and rock greater than 1" in diameter and meeting the following requirements.
 - 1. Plastic index of not more than 30 - ASTM D424.
 - 2. Provide imported fill material as required to complete the work. Obtain the rights and pay all costs for imported fill.

PART 3: EXECUTION

3.1 UNDERGROUND UTILITIES AND SUBSURFACE CONDITIONS:

- A. Known subsurface conditions and underground utilities are shown on the Drawings. Notify the Landscape Architect of any subsurface conditions which will affect the work.

- B. Locate and confirm the location (PA One-Call) of all underground utility lines prior to the start of excavation.
- C. Repair any underground utilities damaged by the Contractor during the progress of this work. The cost of all repair shall be at the Contractor's expense.

3.2 SITE PREPARATION:

- A. Subgrade conditions must be approved by the Landscape Architect prior to installation of topsoil. Verify sub-grade conditions. Any areas not in conformance to the grading plans and tolerances as stated in the Earthwork Section of the Specifications should be brought to the attention of the Landscape Architect.
- B. Do not proceed with the installation of soils until all utility work has been installed.
- C. Protect adjacent site elements such as walls, lights, paving or walks, from damage. Use plywood to cover adjacent surfaces where required.
- D. Repair any damaged site elements at the Contractor's expense.
- E. Remove all paving and rubble when encountered to a depth of 6" below the design subgrade. Replace excavated material with clean fill material and compact to 95% dry density.

3.3 TOPSOIL INSTALLATION

- A. Scarify surface of subgrade by mechanical means to a minimum depth of 2" prior to installation of topsoil.
- B. Install the topsoil to the depths as indicated on the Drawings.
- C. For topsoil depths over 8", lightly compact each lift sufficiently to prevent setting, do not compact to prevent the movement of water and feeder roots through the soil.
- D. Maintain optimum moisture conditions within the soils during installation to allow for satisfactory compaction. Suspend installation operations if the soil becomes wet. Do not place soils on wet or frozen sub grade.
- E. Provide adequate equipment to achieve consistent and uniform compaction of the soils. Do not use vibrator equipment to compact topsoil or planting mix.
- F. Protect topsoil from compaction after placement. Any area which becomes compacted shall be tilled to a depth of 8". Any uneven, eroded, damaged or settled areas shall be filled and re-graded.

3.4 FINE GRADING:

- A. Grade the finish surface of all disturbed areas to meet the grades shown on the Drawings. Adjust the finish grades to meet field conditions.

1. Provide for positive drainage from all areas toward inlets and drainage structures.
 2. Provide smooth transitions between slopes of different gradients and direction. Modify the grade so that the finish grade is 1" below all paving surfaces. When a typical section is given to define the slopes, adhere to the criteria of the section wherever possible.
 3. Fill all dips and remove any bumps in the overall plane of the slope. Tolerance for dips and bumps: 1/2" deviation from plane in 10'.
 4. All fine grading shall be inspected and approved by the Landscape Architect prior to planting, mulching or seeding.
- 3.5 CLEAN UP:
- A. Upon completion of topsoil placement and grading clean areas within the Limit of Work.
 1. Remove all excess fill, soils and stockpiles and legally dispose of all waste materials, trash and debris.
 2. Remove all tools and equipment and provide a clean clear site.
 3. Wash all paving and other exposed surfaces of dirt and mud.

END OF SECTION 32 91 19

SECTION 32 92 19 - SEEDING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Section Includes:

- 1. Fertilizing.
- 2. Seeding.
- 3. Hydroseeding.
- 4. Mulching.
- 5. Maintenance.

- B. Related Sections:

- 1. Section 31 22 13 - Rough Grading: Rough grading of site.
- 2. Section 31 23 16.13 - Trenching: Rough grading over cut.
- 3. Section 32 91 13 - Soil Preparation
- 4. Section 32 91 19 - Landscape Grading: Preparation of subsoil and placement of topsoil in preparation for the Work of this section.
- 5. Section 32 93 00 - Plants.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT – NOT USED

1.4 REFERENCES

- A. ASTM International:

- 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

- B. PennDOT Publication 408, current edition.

- C. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.

1.5 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit data for seed mix, fertilizer, and mulch, and other accessories.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height.

1.8 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.
- B. Perform Work in accordance with PennDOT Publication 408 standards
- C. Perform Work in accordance with the PADEP Erosion and Sediment Pollution Control Program Manual and Drawings.

1.9 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.11 MAINTENANCE SERVICE

- A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for two cuttings.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

- A. Furnish materials in accordance with PennDOT Publication 408 standards
- B. Seed Mixture: As specified on the plans in accordance with Conservation District standards.

2.2 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

- B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil
- C. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- C. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.
- D. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify prepared soil base is ready to receive the Work of this section.

3.2 FERTILIZING

- A. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.
- B. Apply fertilizer at application rate recommended by soil analysis.
- C. Apply after smooth raking of topsoil
- D. Do not apply fertilizer at same time or with same machine used to apply seed.
- E. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

- A. Apply seed at rate as specified on the plans evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: Per Conservation District and PennDOT Publication 408 regulations

- D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph
- E. Immediately following seeding and compacting, apply mulch to thickness of 1/8 inches. Maintain clear of shrubs and trees.
- F. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

- A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate specified by the Conservation District
- B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.5 SEED PROTECTION

- A. Cover seeded slopes where grade is 3:1 or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- B. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.
- C. Secure outside edges and overlaps at 36-inch intervals with stakes.
- D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.6 MAINTENANCE

- A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- D. Water to prevent grass and soil from drying out.
- E. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- F. Immediately reseed areas showing bare spots.
- G. Repair washouts or gullies.
- H. Protect seeded areas with warning signs during maintenance period.

END OF SECTION 32 92 19

SECTION 32 93 90 – EXTERIOR PLANTING

PART 1 – GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground cover and plants.
 - 4. Lawn Seeding.
 - 5. Slope Seeding.
 - 6. ‘No Mow’ Seeding.
 - 7. Topsoil and soil amendments.
 - 8. Fertilizers and mulches.

1.3 SUBMITTALS

- A. Plant source list: Within 30 days of contract award, submit list for nursery sources for all plants. Plants must meet the specified standards when delivered to the project site. Plants not meeting specified standards shall be rejected and replaced at the Contractor’s expense.

1.4 QUALITY ASSURANCE

- A. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."
- B. Installer Qualifications: Engage an experienced Installer who has completed landscaping work in the past five (5) years of similar scope and scale to that indicated for this Project and with a record of successful landscape establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress. Experience is to be a minimum of five (5) years as a supervisor.
 - a. Commercial Pesticide Applicator: State licensed
- C. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect's satisfaction, based on evaluation of agency-submitted

criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

D.

E. Certification of Grass Seed: From seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for identifying source, including name and telephone number of supplier.

F. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.

G. Substitutions: In the event that specified plant material is not available, approval for an appropriate equivalent plant must be obtained prior to ordering of plant material. No substitutions for plant species and varieties will be permitted without approval by the Landscape Architect

H. Placement: Prior to plant installation, proposed locations of plant material shall be placed in the field for approval by the Landscape Architect prior to installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at the project site.

B. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.

C. Handle balled and burlapped stock by the root ball.

D. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.

2. Do not remove container-grown stock from containers before time of planting.

3. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 WARRANTY

- A. Special Warranty: Warrant the specified planting materials for a period of one year after date of Substantial Completion against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground covers and plants.
 - 4. Lawn Seeding.
 - 5. Slope Seeding.
 - 6. 'No Mow' Seeding.
- B. Remove and replace dead plant materials immediately unless required to plant in the succeeding planting season.
- C. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- D. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.7 TREE AND SHRUB MAINTENANCE

- A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for the following period:
 - 1. Maintenance Period: 12 months following Substantial Completion.

1.8 GROUND COVER AND PLANT MAINTENANCE

- A. Maintain ground cover and plants by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings for the following period:
 - 1. Maintenance Period: 12 months following Substantial Completion.

1.9 LAWN MAINTENANCE

- A. Begin maintenance of lawn areas immediately after each area is planted and continue until acceptable lawn is established.

- B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting and repairing seeded areas. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
- C. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Mowing is not required for 'No Mow' and Slope Seeding areas.
- D. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

2.2 GROUND COVER, PLANTS AND LANDSCAPE PLUGS

- A. Provide ground covers and plants established and well rooted in removable containers or integral peat pots and with not less than the minimum number and length of runners required by ANSI Z60.1 for the pot size indicated.

2.3 LAWN AND SLOPE SEEDING

- A. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
 - 1. Lawn Seed Mix: E.H. Griffith "Tall Fescue Plus" Mix. Proportioned by weight as follows:
 - a. 25 percent Titanium Tall Fescue
 - b. 25 percent Inferno Tall Fescue
 - c. 25 percent Hemi Tall Fescue
 - d. 20 percent Traverse 2 SRP Tall Fescue
 - e. 5 percent Brooklawn Kentucky Bluegrass
 - f. Supplier: E.H. Griffith Inc., P.O. Box 8319 Palmer Street, Pittsburgh, PA 15218 (412) 271-3365.

2. Slope Seed Mix: ERNMX-181 Native Steep Slope Mix with Annual Ryegrass.
 - a. Supplier: Ernst Conservation Seeds, 8884 Mercer Pike, Meadville, PA, 800-873-3321. Ernstseed.com.
3. 'No Mow' Seed Mix: Scottish Links Mix .
 - a. Supplier: Jacklin Seed, Toll Free: 1-800-688-SEED. www.jacklin.com. E-mail: info@jacklin.com

2.4 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.
 1. Topsoil Source: Import topsoil from off-site sources. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from bogs or marshes.

2.5 SOIL INOCULANT

- A. Soil Inoculant that contains beneficial soil microorganisms such as; fungi, bacteria and amino acids and vitamins. Submit sample to Landscape Architect for approval prior to combining with Root Zone Mix. Basis of design: PGA.

2.6 SOIL AMENDMENTS

- A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.
 1. Provide lime in the form of dolomitic limestone.
- B. Aluminum Sulfate: Commercial grade, unadulterated.
- C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
- F. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
- G. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

- H. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
- I. Herbicides: EPA registered and approved, of type recommended by manufacturer.
- J. Water: Potable.

2.7 FERTILIZER

- A. Starter Fertilizer: Lebanon Proscape 21-22-4 W/Mesotrione, 40Lbs/ Bag, SGN 125. Derived from: Methylene Ureas, Urea, Murated of Potassium Sulfate, Ammonium Phosphate and Ferrous Sulfate 5.6% Slowly available Nitrogen from Methylene Ureas. Supplier: E.H. Griffith Inc., P.O. Box 8319 Palmer Street, Pittsburgh, PA 15218 (412) 271-3365. Application Rate: 10,000 Sq. Ft./Bag.
- B. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
- E. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 5 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight.

2.8 MULCHES

- A. Organic Mulch: for trees, shrubs and perennials. Double shredded bark mulch, free from deleterious materials and suitable as a top dressing of tree, shrub and perennial beds.
- B. Mushroom Manure: for groundcovers.
 - 1. Type: Per PennDOT Publication 408 2020 Section 805- Mulching (Spent Mushroom Soil Compost).
- C. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- D. Peat mulch may be required if seeded lawns are subject to hot, dry weather or drying winds within 30 days of planting.
- E. Peat Mulch: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

- F. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows: Organic Matter Content: 50 to 60 percent of dry weight.
- G. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- H. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- I. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- J. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.9 MISCELLANEOUS MATERIALS

- A. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- B. Tree Watering Bags: UV stabilized polyethylene bag with scrim reinforcement. Basis-of-Design Product: 'Tregator Original' as manufactured by Spectrum Products, inc. (www.tregator.com or 1-866-873-3428).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- C. Moisten prepared root zone mixture before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.2 LAWN PREPARATION

- A. Limit lawn subgrade preparation to areas to be planted.
- B. Lawn Areas: Loosen subgrade to a minimum depth of 4 inches. Remove stones sticks, roots, rubbish, and other extraneous matter and legally dispose from Owner's property.
- C. Apply superphosphate fertilizer directly to subgrade before loosening.
- D. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
- E. Delay mixing fertilizer with topsoil if planting will not proceed within (3) days.
- F. Mix lime with dry soil before mixing fertilizer.
- G. Spread topsoil to a minimum depth of 6 inches to meet finish grades after light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet.
- H. Spread topsoil to 2 inch depth on 2:1 slopes.
- I. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:
- J. Rototill topsoil to a depth of 4 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
- K. Apply superphosphate fertilizer directly to surface soil before loosening.
- L. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
- M. Legally dispose of waste material, including grass, vegetation, and turf from Owner's property.
- N. Finish Grading (Lawn Areas): Fine grade lawn areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted immediately.
- O. Finish Grading (Slope Seeding areas): Grade slope seeding areas to a uniform slope. Remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted immediately.
- P. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- Q. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.3 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
- B. Seeding Rates:
 - 1. Lawn Seeding: 8 lbs/1,000 s.f. Install Lawn Seeding mixture on areas indicated on the Drawings.
 - 2. Slope Seeding: 1 lbs/1,000 s.f. Install Slope Seeding mixture on 2:1 slopes indicated on the Drawings.
 - 3. 'No Mow' Seeding: 8 lbs/1,000 s.f. Install 'No Mow' Seeding mixture on areas indicated on the Drawings.
 - 4. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
- C. Protect 2:1 sloped areas with erosion-control blankets according to manufacturer's written instructions.
- D. Protect seeded areas with slopes not exceeding 2:1 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment. Bond straw mulch by spraying with asphalt emulsion at the rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- E. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with asphalt-emulsion tackifier.
 - 2. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb/acre.

3.4 SATISFACTORY LAWNS

- A. Satisfactory Seeded Lawn: At Certificate of Completion date, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 95 percent over any 10 sq. ft. and bare spots not exceeding 3 inches by 3 inches.
- B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.5 PLANTING SOIL PREPARATION

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.

3.6 GROUND COVER AND PLANT BED PREPARATION

- A. Loosen subgrade of planting bed areas to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous materials.
- B. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.

3.7 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation.
- B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.

3.8 PLANTING TREES AND SHRUBS

- A. Set trees and shrubs plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated. Install Tree watering bags size as required and in accordance with manufacturers instructions.

3.9 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are size after pruning.

3.10 PLANTING GROUND COVER, PLANTS AND LANDSCAPE PLUGS

- A. Space ground cover and plants as indicated.
- B. Dig holes large enough to allow spreading of roots, and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

3.11 MULCHING

- A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated within 48 hours of planting.
- B. Organic Mulch: Apply the 3 inch average thickness of double shredded bark mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.

3.12 SATISFACTORY LAWNS

- A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.13 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.

3.14 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose from the Owner's property.

END OF SECTION 32 93 90

SECTION 32 94 13 – LANDSCAPE EDGING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Aluminum Edging

1.3 DESCRIPTION

- A. Extent of landscape edging work as shown on Drawings, in schedules and as specified herein.
- B. Furnish all labor, equipment and materials necessary to complete the installation of all work indicated on the drawings, herein specified or both. Work includes but is not limited to the following items:
 - 1. Aluminum Edging

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: 12” section of Aluminum Edging with stake.
- C. Maintenance data/instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and protect from damage and mishandling. Protect materials from deterioration during delivery, and while stored at site. Any specified material or product which has been damaged to any extent during shipping shall be returned to the Manufacturer for replacement. After shipment and acceptance by the Contractor any material or product damaged during storage or handling shall be removed from the site and replaced at the expense of the Contractor.

1.6 WARRANTIES

- A. At the time of Final Inspection submit to the Owner all certificates of Manufacturer's Warranty or Guarantee and any stipulation thereof.

PART 2 - PRODUCTS

2.1 ALUMINUM EDGING

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide CleanLine Aluminum Edging as manufactured by: PermaLoc Corporation. www.permaloc.com Holland, MI 1.800.356.9660 or 616-399-9660 or approved equal.
- 2. Size: 1/8" x 4", with natural aluminum finish. 16'-0" sections to include (5) aluminum stakes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install landscape edging in strict accordance with manufacturer's specifications and recommendations.
- B. Install landscape edging level, plumb, true, and securely anchored positioned at locations indicated on Drawings.
 - 1. Install all landscape edging in accordance with the Drawings and manufacturer's specifications and details. All landscape edging locations and layout shall be approved by Landscape Architect prior to installation.

3.2 CLEANUP AND PROTECTION

- A. During landscape edging work, keep all areas clean and in an orderly condition.
- B. Protect landscape edging work and materials from damage due to other operations and operations by other Contractors. Maintain protection during installation and maintenance periods.
- C. Where inspected landscape edging does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by the Landscape Architect and found to be acceptable. Remove rejected materials and products promptly from project site.

3.3 DISPOSAL OF WASTE MATERIALS

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- A. Debris from landscape edging shall be removed and legally disposed of off-site. No debris may be stored on site. Remove daily from the site and do not allow debris to accumulate.

END OF SECTION 32 94 13

SECTION 33 10 00 - WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of underground water distribution for domestic and/or fire supply systems outside the building that are complete and ready for operation. This includes piping, structures, appurtenances, and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 23 16, EXCAVATION and 31 23 16.13, TRENCHING.
- B. Concrete: Section 03 30 00, CAST IN-PLACE CONCRETE.
- C. Fire Protection System connection: Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- D. General plumbing: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Erosion and Sediment Control: Section 31 25 00, EROSION CONTROLS.

1.3 DEFINITIONS

- A. Water distribution system: Pipelines and appurtenances which are part of the distribution system outside the building for potable water and fire supply.
- B. Water service line: Pipeline from main line to 5 feet outside of building.

1.4 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic.
- B. DI: Ductile iron pipe.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends and flange faces.
- B. Use a sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

- D. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- E. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.
- F. Cleanliness of Piping and Equipment Systems:
 - 1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading, and welding of piping shall be removed.
 - 2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.

1.6 COORDINATION

- A. Coordinate connection to water main with Public Utility company.
- B. Coordinate water service lines with building contractor.

1.7 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least three years. Digital electronic devices, software, and systems such as controls, instruments or computer workstations shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
- C. Regulatory requirements:
 - 1. Comply with the rules and regulations of the Public Utility Company having jurisdiction over the connection to public water lines and the extension and/or modifications to public utility systems.
 - 2. Comply with the rules and regulations of the Local Health Department having jurisdiction for potable water-service.
 - 3. Comply with rules and regulations of Local authorities having jurisdiction for fire-suppression water-service piping including materials, hose threads, installation, and testing.

- D. Provide certification of factory hydrostatic testing of not less than 500 psi (3.5 MPa) in accordance with AWWA C151. Piping materials shall bear the label, stamp, or other markings of the specified testing agency.
- E. Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
 - 1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 - 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 - 3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 - 4. All welds shall be stamped according to the provisions of the American Welding Society.
- F. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Owner's Representative prior to installation.
- G. Applicable codes:
 - 1. Plumbing Systems: IPC, International Plumbing Code.
 - 2. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
 - 3. Fire-service main products shall be listed in the FM Global "Approval Guide" or Underwriters Laboratories (UL) "Fire Protection Equipment Directory".

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - MSS SP-60-2004Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
 - MSS SP-108-2002Resilient-Seated Cast Iron, Eccentric Plug Valves
 - MSS SP-123-1998(R2006)Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube
- C. American Society of Mechanical Engineers (ASME):

A112.1.2-2004.....	Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors))
A112.6.3-2001.....	Floor Drains
B16.1-2010.....	Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250
B16.18-2001.....	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-2001.....	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.24-2006.....	Cast Copper Alloy Pipe Flanges and Flanged Fittings; Classes 150, 300, 600, 900, 1500 and 2500
B31.....	Code for Pressure Piping Standards

D. American Society for Testing and Materials (ASTM):

A36/A36M-08.....	Carbon Structural Steel
A48/A48M-08(2008).....	Gray Iron Castings
A536-84(2009).....	Ductile Iron Castings
A674-10.....	Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
B61-08.....	Steam or Valve Bronze Castings
B62-09.....	Composition Bronze or Ounce Metal Castings
B88/B88M-09.....	Seamless Copper Water Tube
C651-05.....	Disinfecting Water Mains
C858-10e1.....	Underground Precast Utility Structures
D1785-06.....	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2239-03.....	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter
D2464-06.....	Threaded Poly (Vinyl Chloride) PVC Pipe Fittings, Schedule 80
D2466-06.....	Poly (Vinyl Chloride) (PVC) Pipe Fittings, Schedule 40
D2467-06.....	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D2609-02(2008)Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
D3350-10a.....Polyethylene Plastics Pipe and Fittings Materials
F714-10Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside
Diameter
F1267-07Metal, Expanded, Steel

E. American Water Works Association (AWWA):

B300-10.....Hypochlorites
B301-10.....Liquid Chlorine
C104-08.....Cement–Mortar Lining for Ductile Iron Pipe and Fittings
C105/A21.5-10Polyethylene Encasement for Ductile Iron Pipe Systems
C110-08.....Ductile Iron and Gray-Iron Fittings
C111/A21.11-07Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
C115/A21.11-11Flanged Ductile Iron Pipe with Ductile Iron or Gray-Iron
Threaded Flanges
C151/A21.51-09Ductile Iron Pipe, Centrifugally Cast
C153/A21.53-11Ductile Iron Compact Fittings for Water Service
C502-05.....Dry-Barrel Fire Hydrants
C503-05.....Wet-Barrel Fire Hydrants
C504-10.....Rubber-Seated Butterfly Valves
C508-09.....Swing-Check Valves for Waterworks Service, 2-In. Through 24-
In. (50-mm Through 600-mm) NPS
C509-09.....Resilient-Seated Gate Valves for Water Supply Service
C510-07.....Double Check Valve Backflow Prevention Assembly
C511-07.....Reduced-Pressure Principle Backflow Prevention Assembly
C512-07.....Air Release, Air/Vacuum and Combination Air Valves
C550-05.....Protective Interior Coatings for Valves and Hydrants

C600-10.....	Installation of Ductile Iron Mains and Their Appurtenances
C605-11.....	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
C606-11.....	Grooved and Shouldered Joints
C651-05.....	Disinfecting Water Mains
C700-09.....	Cold-Water Meters, "Displacement Type," Bronze Main Case
C800-05.....	Underground Service Line Valves and Fittings
C900-09.....	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
C906-07.....	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 64 In. (1,600 mm), for Water Distribution and Transmission
C907-04.....	Injection-Molded PVC Pressure Fittings, 4 Inch through 12 Inch (100 mm through 300 mm), for Water Distribution
M23-2nd Ed.....	PVC Pipe, Design and Installation
M44-2nd Ed.....	Distribution Valves: Selection, Installation, Field Testing and Maintenance

F. National Fire Protection Association (NFPA):

NFPA 24-2010 Ed.	Installation of Private Fire Service Mains and Their Appurtenances
NFPA 1963-2009 Ed.	Fire Hose Connections

G. NSF International (NSF):

NSF/ANSI 14 (2013)	Plastics Piping System Components and Related Materials
NSF/ANSI 61-2012.....	Drinking Water System Components - Health Effects
NSF/ANSI 372-2011.....	Drinking Water System Components – Lead Content

H. American Welding Society (AWS):

A5.8/A5.8M-2004	Filler Metals for Brazing and Braze Welding
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I. American Society of Safety Engineers (ASSE):

1003-2009	Water Pressure Reducing Valves
1015-2009	Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
1020-2004	Pressure Vacuum Breaker Assembly
1047-2009	Performance Requirements for Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies
1048-2009	Performance Requirements for Double Check Detector Fire Protection Backflow Prevention Assemblies
1060-2006	Performance Requirements for Outdoor Enclosures for Fluid Conveying Components

J. Underwriters' Laboratories (UL):

246	Hydrants for Fire-Protection Service
262	Gate Valves for Fire-Protection Service
312	Check Valves for Fire-Protection Service
405	Fire Department Connection Devices
753	Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service
789	Indicator Posts for Fire-Protection Service
1091	Butterfly Valves for Fire-Protection Service
1285	Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF/ANSI 61 or NSF 372.

- B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

2.2 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. The contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.3 SAFETY GUARDS

- A. All equipment shall have moving parts protected to prevent personal injury.

2.4 LIFTING ATTACHMENTS

- A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 DUCTILE IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, round-grooved ends.
 - 1. Grooved-End, Ductile-Iron Pipe Appurtenances: ASTM A47, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe, 350 psi (3400 kPa).
 - 2. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions, Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

- 3. Gaskets: AWWA C111.
- D. Flanged Ductile Iron Pipe: AWWA C115/A21.11, with factory applied screwed long hub flanges.
 - 1. Flanges: ASME B16.1 for 250 psi (1725 kPa) pressure ratings, as necessary.
 - 2. Wall Sleeve Castings, size and types shown on the drawings, shall be hot dipped galvanized per ASTM A123.
 - 3. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall be shop primed with one coat of rust inhibitive primer. Final paint color shall match the final wall color.
- E. Exterior Pipe Coating: The exterior of pipe shall have the standard asphaltic coating or as otherwise approved by the Owner's Representative

2.6 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. PVC, Schedule 80 Pipe: ASTM D1785.
 - 1. PVC, Schedule 80 Socket Fittings: ASTM D2467.
 - 2. PVC, Schedule 80 Threaded Fittings: ASTM D2464.
- B. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends.
Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends.
Include elastomeric gasket in each bell.
 - 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.7 COPPER TUBE AND FITTINGS

- A. Soft Copper Tubing: ASTM B88, Type K / water tube, annealed temper.
- B. Hard Copper Tubing: ASTM B88, Type K water tube, drawn temper.
- C. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper alloy solder joint pressure fittings.

- D. Brazing Alloy: AWS A5.8/A5.8M, Classification BCuP.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder joint ends. ASME B16.24, Class 300 flanges if required to match piping.
- F. Copper Unions: ANSI MSS SP-123, cast copper alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.8 VALVES

- A. Gate Valves: AWWA C509, Non-rising Stem, Resilient Seat, 200 psi (1380 kPa).
 - 1. Valves 3 inches (75 mm) and larger: Resilient seat valve with gray- or ductile iron body and bonnet; cast iron or bronze double-disc gate; bronze gate rings; non-rising bronze stem and stem nut.
 - 2. Interior and exterior coating: AWWA C550, thermo-setting or fusion epoxy.
 - 3. Underground valve nut: Furnish valves with 2-inch (50 mm) nut for socket wrench operation.
 - 4. Aboveground and pit operation: Furnish valves with hand wheels.
 - 5. End connections shall be mechanical joint.
- B. Gate Valve Accessories and Specialties
 - 1. Tapping-Sleeve Assembly: ANSI MSS SP-60; sleeve and valve to be compatible with the drilling matching.
 - a. Tapping Sleeve: Ductile Iron, two-piece bolted sleeve. Sleeve to match the size and type of pipe material being tapped.
 - b. Valve shall include one raised face flange mating tapping-sleeve flange.
 - 2. Valve Boxes: AWWA M44 with top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel.
 - 3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut. (Provide two wrenches for Project.)
 - 4. Indicator Posts: UL 789, FMG approved, vertical type, cast iron body with operating wrench, extension rod, and adjustable cast iron barrel of length required for depth of burial of valve.
- C. Swing Check Valves:
 - 1. Valves smaller than 2 inches (25 mm): ASTM B61, resilient seat, bronze body and bonnet, pressure rating of 200 psi (1380 kPa). Ends to match main line piping.
 - 2. Valves 2 inches (25 mm) or larger: AWWA 508, resilient seat valve with iron body and bonnet, pressure rating of 200 psi (1380 kPa).

3. Coating: AWWA C550, fusion epoxy coated.

D. Detector Check Valves

1. Galvanized cast iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - a. Standards: UL 312 and FMG approved, 175 psi (1207 kPa).
 - b. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

E. Butterfly Valves

1. Rubber-Seated Butterfly Valve: AWWA C504.
 - a. Provide rubber seated butterfly valve ductile iron body flanged, minimum pressure of 150 psi (1035 kPa).
2. UL Butterfly Valve: UL 1091 and FMG approved.
 - a. Provide metal on resilient material seating butterfly valves that are UL 1091 and FMG approved, ductile iron body flanged minimum pressure of 175 psi (1207 kPa).

- F. Plug Valves:** ANSI MSS SP-108, resilient-seated eccentric plug valve, minimum pressure of 175 psi (1207 kPa).

G. Corporation Valves and Curb Valves

1. Service-Saddle Assemblies: AWWA C800.
 - a. Service Saddle: Copper alloy with seal and threaded outlet for corporation valve.
 - b. Corporation Valve: Bronze body and ground-key plug, with threaded inlet and outlet matching service piping material.
 - c. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
2. Curb Valves: AWWA C800, bronze body, ground-key plug or ball, wide tee head, with inlet and outlet matching service piping material, minimum pressure of 200 psi (1375 kPa).
3. Service Boxes for Curb Valves: AWWA M44, cast iron telescoping top section; plug shall include lettering "WATER"; bottom section with base that fits over curb valve.
4. Shutoff Rods: Steel, tee-handle with one pointed end. Stem length shall extend 2 feet (600 mm) above top of valve box for operation of deepest buried valve, with slotted end matching curb valve.

- H. Post-Indicator:** NFPA 24 and be fully compatible with the valve and supervisory switches.

2.9 WATER METER VAULT

A. General

1. Domestic Service and Fire Service shall be separately piped and metered, however both services shall be located together within a single metering vault.
2. The types and sizes of meters and backflow prevention devices will be determined by the local Water Authority (Wilkinsburg-Penn Joint Water Authority). Contractor shall coordinate with the local Water Authority in determining meter and backflow prevention device types and sizes to be provided based on these Specifications and the Plans.
3. The Owner intends that the Water Meter Vault be manufactured and supplied as a pre-plumbed water meter vault. Manufacturer shall be AR Chambers or approved Equal. This, however, shall in no way relieve the Contractor from providing a complete turn-key operational system with all required and otherwise necessary equipment and components.

B. Piping, Meters, Valves and Appurtenances

1. Piping: DIP.
2. Water Control/Isolation Valves: Gate valve.
3. Strainers: Neptune, or approved Equal.
4. Domestic Service Meter: Per local Water Authority.
5. Fire Service Meter: Per local Water Authority.
6. Backflow Prevention Devices: Per local Water Authority.

C. Concrete Vault

1. The length and width dimensions of the water meter vault shown on the Plans are notional and final dimensions depend on the local Water Authority determination of type of meter and backflow prevention devices. The Contractor shall coordinate and determine final dimensional requirements between the local Water Authority designated equipment, concrete vault manufacturer standard sizes, and these Specifications and the Plans.
2. Precast, solid floor reinforced-concrete vault: ASTM C858, designed for AASHTO H20-44 load designation.
3. Minimum six-foot six-inch (6'-6") head clearance within the precast vault.
4. Access Hatch: Minimum four feet (4') wide by four feet (4') long double leaf with square key lock and recessed handles.
5. Ladder: Locate directly under access hatch. ASTM A36, steel or polyethylene-encased steel steps.

6. Drain: ASME A112.6.3, cast iron floor drain with outlet. Include body anchor flange, light-duty cast iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.10 FLUSHING HYDRANTS

- A. Post-Type Flushing Hydrants: Non-freeze and drainable, of length required for shutoff valve installation below frost line.
 1. Pressure Rating: 150 psi (1035 kPa) minimum
 2. Outlet: One, with horizontal discharge
 3. Hose Thread: NPS 2-1/2 (DN 65), with NFPA 1963 external hose thread for use by local fire department, and with cast iron cap with brass chain
 4. Barrel: per local fire department with breakaway feature
 5. Valve: Bronze body with bronze-bal, and automatic draining
 6. Security: Locking device for padlock
 7. Exterior Finish: Red alkyd-gloss enamel paint.
 8. Inlet: NPS 2 (DN 50) minimum
 9. Operating Wrench: One for each unit
- B. Ground-Type Flushing Hydrants: Non-freeze and drainable, of length required for shutoff valve installation below frost line.
 1. Pressure Rating: 150 psi (1035 kPa) minimum
 2. Outlet: One, with angle discharge
 3. Hose Thread: NPS 2-1/2 (DN 65), with NFPA 1963 external hose thread for use by local fire department, and with cast iron cap with brass chain
 4. Barrel: Cast iron
 5. Valve: Bronze body with bronze-ball, and automatic draining
 6. Inlet: NPS 2 (DN 50) minimum
 7. Hydrant Box: Cast iron with cover, for ground mounting
 8. Operating Wrench: One for each unit
- C. Post-Type Sampling Station: Non-freeze and drainable, of length required for shutoff valve installation below frost line.
 1. Pressure Rating: 100 psi (690 kPa) minimum
 2. Sampling Outlet: One unthreaded nozzle with handle
 3. Valve: Bronze body with bronze-ball. Include operating handle.
 4. Drain: Tubing with separate manual vacuum pump

5. Inlet: NPS 3/4 (DN 20) minimum
6. Housing: Weatherproof material with locking device. Include anchor device.
7. Operating Wrench: One for each unit

2.11 FIRE HYDRANTS

1. In accordance with local Fire Department requirements.

2.12 FIRE DEPARTMENT CONNECTIONS

- A. In accordance with local Fire Department requirements.

2.13 DISINFECTION CHLORINE

- A. Liquid chlorine: AWWA B301.
- B. Sodium Hypochlorite: AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite: AWWA B300 supplied in granular form of 5 g. tablets and shall contain 65 percent chlorine by weight.

2.14 WARNING TAPE

- A. Warning tape shall be standard, 4 mil. Polyethylene, 3 inch (76 mm) wide tape, detectable type, blue with black letters and imprinted with "CAUTION BURIED WATER LINE BELOW".

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Use pipe, fittings, and joining methods for piping systems according to the following applications.
 1. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
 2. Do not use flanges or unions for underground piping.
 3. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- B. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be any of the following, however all materials shall be the same and consistent throughout the Project:
 1. Soft copper tube with wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.
 2. PE, ASTM pipe; molded PE fittings; and heat-fusion joints.
 3. PVC, Schedule 80 pipe, socket fittings; and solvent-cemented joints.

- C. Underground water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be any of the following:
1. Ductile iron, push-on-joint pipe; ductile iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile iron, mechanical-joint fittings.
 2. PVC, AWWA Class 150 pipe for NPS 4 and NPS 6 (DN 100 and DN 150): NPS 6 (DN 150) PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 fabricated or molded fittings; and gasketed joints.
 3. PVC, AWWA Class 200 pipe for NPS 8 (DN 200): PVC, AWWA Class 200 fabricated push-on-joint, ductile iron mechanical-joint, ductile iron fittings; and gasketed joints.
- D. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 (DN 20 to DN 50) shall be same as underground water-service piping.
- E. Aboveground and Vault Water-Service Piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be any of the following:
1. Hard copper tube with wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.
- F. Aboveground and vault water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be any of the following:
1. Ductile iron, grooved-end pipe; ductile iron, grooved-end appurtenances; and grooved joints.
- G. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be any of the following:
1. Ductile iron, push-on-joint pipe; ductile iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile iron-pipe appurtenances; and grooved joints.
 2. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
- H. Aboveground and Vault/Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be ductile iron, grooved-end pipe; ductile iron-pipe appurtenances; and grooved joints.

3.2 VALVE APPLICATIONS

- A. Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, non-rising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.

- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, non-rising-stem, resilient - seated gate valves with valve box.
 2. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast iron, non-rising-stem gate valves with indicator post.
 3. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, non-rising stem.
 - b. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.

3.3 DUCTILE IRON PIPE

- A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.
1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105/A21.5.
- B. Pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Push on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead.

3.4 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe.
- B. Install Copper Tracer Wire, No. 14 AWG solid, single conductor, insulated. Install in the trench with piping to allow location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder per ASTM 828. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 1000 feet (300 m) provide a 5-pound (2.3 kg) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall also be attached at the end of each line.

3.5 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations.
- B. Copper piping shall be bedded in 6 inches (150 mm) of sand.

3.6 ANCHORAGE INSTALLATION

- A. Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include concrete thrust blocks, locking mechanical joints, set-screw mechanical retainer glands, bolted flanged joints, pipe clamps and tie rods.
- B. Install anchorages for tees, plugs, and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

- A. AWWA Valves: Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Valves: Install each underground valve and valves in vaults with stem pointing up and with vertical cast iron indicator post.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- E. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. // Install full-size valved bypass. //
- F. Relief Valves: Install aboveground with shutoff valve on inlet.
- G. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.8 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground and for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

- B. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.9 WATER METER INSTALLATION.

- A. Install water meters, piping, and specialties according to utility company's written instructions.

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with one (1) above surface.

3.12 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.13 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow Preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow Preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow Preventers.
- D. Support NPS 2-1/2 (DN 65) and larger backflow Preventers, valves, and piping near floor and on brick or concrete piers.

3.14 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C891.

3.15 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately one (1) inch above grade.

- B. Install protective enclosure over valves and equipment and anchor protective enclosure to concrete base.

3.16 FLUSHING HYDRANT INSTALLATION

- A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.
- B. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.
- C. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.

3.17 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire department connection to mains.
- B. Install protective pipe bollards on two sides of each fire department connection.

3.18 FIRE HYDRANT INSTALLATION

- A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Install Wet-Barrel Fire Hydrants with valve below frost line. Provide for drainage.

3.19 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install water service lines to a point of connection within approximately 5 feet (1500 mm) outside of building(s) to which service is to be connected and make connections thereto. If building services have not been installed provide temporary caps and mark for future connection.

3.20 FIELD QUALITY CONTROL

- A. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- C. Perform hydrostatic tests at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psi (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psi (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare reports of testing activities.

3.21 IDENTIFICATION

- A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

3.22 CLEANING

- A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- B. Use purging and disinfecting procedure prescribed by local utility provider or other authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
1. Fill the water system with a water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 2. Drain the system of the previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow system to stand for 3 hours.
 3. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- C. Prepare reports of purging and disinfecting activities.

END OF SECTION 33 10 00

SECTION 33 30 00 - SANITARY SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside site, underground sanitary sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 23 16, EXCAVATION and 31 23 16.13, TRENCHING..
- B. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- C. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATION.
- D. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 31 25 00, EROSION CONTROLS.

1.3 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic
- B. DI: Ductile iron pipe

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- B. Handle manholes according to manufacturer's written rigging instructions.

1.5 COORDINATION

- A. Coordinate connection to sanitary sewer main with Public Utility company. Approval from public utility has been obtained indicating that the downstream sanitary systems have sufficient capacity to handle the sanitary discharge from the facility.
- B. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.
- C. Coordinate connection to public sewer system with Public Utility Company.

1.6 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.7 SUBMITTALS:

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and, Appurtenances.
2. Jointing Material.
3. Manhole and Structure Material.
4. Frames and Covers.
5. Steps and Ladders.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A74-09.....	Cast Iron Soil Pipe and Fittings
A185/A185M-07	Steel Welded Wire Reinforcement, Plain, for Concrete
A615/A615M-09b	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A746-99.....	Ductile-Iron Gravity Sewer Pipe
C478-09.....	Precast Reinforced Concrete Manhole Sections
C857-11.....	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C890-11.....	Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

C913-08.....	Precast Concrete Water and Wastewater Structures
C923-08.....	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C924-02(2009)	Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
C990-09.....	Joints for Concrete Pipe, Manholes, and precast Box Sections using Preformed Flexible Joint Sealants
C1173-10.....	Flexible Transition Couplings for Underground Piping Systems
C1440-08.....	Thermoplastic Elastomeric (TPE) Gasket Materials for Drain, Waste and Vent (DWV), Sewer, Sanitary and Storm Plumbing Systems
C1460-08.....	Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground
C1461-08.....	Mechanical Couplings Using Thermoplastic Elastomeric (TPE) Gaskets for Joining Drain, Waste and Vent (DWV), Sewer, Sanitary and Storm Plumbing systems for Above and below Ground Use
D2321-11.....	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D3034-08.....	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
F477-10	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-08	Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F891-10	Coextruded Poly(vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
F949-10	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
F1417-11	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
F1668-08	Construction Procedures for Buried Plastic Pipe

C. American Water Works Association (AWWA):

C105/A21.5-10	Polyethylene Encasement for Ductile-Iron Pipe Systems
C110-08.....	Ductile-Iron and Gray-Iron Fittings
C111/A21.11-06	Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
C151/A21.51-09	Ductile Iron Pipe, Centrifugally Cast
C153/A21.53-06	Ductile Iron Compact Fittings for Water Service
C219-11.....	Bolted, Sleeve-Type Couplings for Plain-End Pipe
C512-07.....	Air Release, Air/Vacuum and Combination Air Valves for Water Works Service
C600-10.....	Installation of Ductile-Iron Mains and Their Appurtenances
C900-07.....	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

D. American Society of Mechanical Engineers:

A112.14.1-2003	Backwater Valves
A112.36.2M-1991	Cleanouts

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements.
- B. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical Joint Piping

- 1. Pipe and Fittings: AWWA C151, thickness // insert class // unless otherwise shown or specified.
- 2. Compact Fittings: AWWA C153.
- 3. Gaskets: AWWA C111.
- 4. Exterior coating: AWWA C151.
- 5. Interior lining shall be as per ASTM A746.

6. Pipe and fittings shall be polyethylene encased as per AWWA C105.

B. Push-on-Joint Piping:

1. Pipe: AWWA C151, thickness // insert class // , with bolt holes in bell.
2. Standard Fittings: AWWA C110.
3. Compact Fittings: AWWA C153.
4. Gaskets: AWWA C111.
5. Exterior coating: AWWA C151.
6. Interior lining: AWWA C151.
7. Pipe and fittings shall be polyethylene encased as per AWWA C105.

2.3 PVC, GRAVITY SEWER PIPE AND FITTINGS

A. PVC Gravity Sewer Piping:

1. Pipe and Fittings shall conform to ASTM F679 SDR 35 and SDR 26.
2. Gaskets: ASTM F477.

2.4 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F477, elastomeric seal.
2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Couplings shall be elastomeric sleeve with stainless steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Couplings shall meet ASTM C1460 with elastomeric sleeve with full-length, corrosion-resistant outer shield with corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger mainline pipe and for spigot of smaller main line pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. Coupling shall be ASTM C1461, sleeve-type, reducing- or transition-type mechanical coupling, molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:

1. Compound fittings: Fittings shall have a combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one gasketed sleeve section, rated for 250-psi (1725-kPa) minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:

1. Jointing Material: Joints shall be a three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psi (1725-kPa) minimum working pressure and for expansion indicated.

C. Ductile-Iron Deflection Fittings:

1. Jointing Material: Compound coupling fittings with ball joint, flexing section, gaskets, and restrained-joint ends shall comply with AWWA C110 or AWWA C153. Include rating for 250-psi (1725-kPa) minimum working pressure and for up to 15 deg of deflection.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Cleanouts shall be as per ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Top-Loading Classification(s): Valve loadings shall be designed for Heavy Duty.
3. Cleanout Riser: Sewer pipe fitting on main line pipe and riser shall be as per ASTM A74, service class.

B. PVC Cleanouts:

1. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.
2. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

2.7 MANHOLES

A. Standard precast concrete manholes and vaults shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections or cast-in-place concrete.

1. Precast Concrete Manholes: Material shall be as per ASTM C478, precast, reinforced concrete, of depth indicated, with sealed joints.

2. Concrete Base: Concrete for base of manhole shall have a minimum compressive strength of 5000 psi (35 MPa) at 28 days. Thickness to be 8 inches (200 mm), minimum.
3. Riser Section: 4 inch (100 mm) minimum thickness, of lengths to provide the total depth of manhole.
4. Top Section: Eccentric-cone type unless otherwise indicated. Top section to match adjustment ring configurations.
5. Joint Sealant: ASTM C990.
6. Resilient Pipe Connectors: ASTM C923.
7. Steps: If over 60 inches (1500 mm) in depth, individual FRP steps or ladder, with 16 inch (400 mm) minimum width, 12 to 16 inches (300 to 400 mm) center-to-center from top to bottom.
8. Adjusting Rings: Reinforced-concrete rings; 6 to 9 inch (150 to 225 mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Concrete Manholes:

1. Description: ASTM C913; designed according to ASTM C890 for AASHTO HS20-44, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: If over 60 inches (1500 mm) in depth, individual FRP steps or FRP ladder; width 16 inches (400 mm) minimum, 12 to 16 inches (300 to 400 mm) center-to-center from top to bottom.
6. Adjusting Rings: Reinforced-concrete rings; 6 to 9 inch (150 to 225 mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Base Channels: Manhole channels shall be main line pipe material. Lay main pipe through manhole and cut top of pipe out to be three-fourths of pipe diameter. Slope through manhole to match run slopes of the main pipe.

2.8 CONCRETE

- A. Cast-in-place concrete shall be 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

B. Reinforcement

1. Reinforcing fabric shall be ASTM A185, steel, welded wire fabric, plain.
 2. Reinforcing bars shall be ASTM A615, Grade 60 (420 MPa) deformed steel.
- C. Benches shall be concrete, sloped to drain into the channel. Provide 6 inches (150 mm) from the cut section of top of pipe to edge of manhole.
- D. Ballast and Pipe Supports shall be Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

2.9 WARNING TAPE

- A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- E. Inspect pipes and fittings for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.
- H. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe
- I. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

- J. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- K. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.
- L. Install gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install piping with minimum cover as shown on Drawings
 - 3. Install ductile iron, gravity sewer piping according to AWWA C600.
 - 4. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.
- M. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.2 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Join ductile iron, gravity sewer piping according to AWWA C600 for push-on joints.
 - 2. Join PVC piping according to ASTM D2321.
 - 3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
 - a. Shielded Rigid couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, rigid couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure pipe couplings for force-main joints.

3.3 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES WITHIN VAULTS

- A. Install reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.4 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 5 feet (1500 mm) outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

3.5 MANHOLE INSTALLATION

- A. Install manholes complete with appurtenances and accessories indicated.
 - 1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
 - 2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed as per manufacturer's recommendations. Adjust the length of the rings so that the top section will be at the required elevation. Cutting the top section is not acceptable.
 - 3. Concrete manhole risers and tops: Install as specified.
- B. Designed Concrete Structures:
 - 1. Concrete structures shall be installed in accordance with Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
- D. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
- E. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade.
- G. Install manhole frames and covers on a mortar bed, such that frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. Install an 8 inches (200 mm) thick, by 12 inches (300 mm) wide concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Cleanouts should be 6 inches (150 mm) in diameter and consist of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches (450 by 450 by 300 mm) 1 inch (25 mm) above surrounding grade.
- C. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 2 inches (50 mm) base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 24 inches (600 mm) in diameter.
- D. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.
- E. The top of the cleanout assembly shall be 2 inches (50 mm) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.7 CONNECTIONS

- A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.
- B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.
- C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.
 2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.
 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.8 REGRADING

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast
- B. iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- C. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed.
 - 1. Piping under and within 5 feet (1500 mm) of building areas shall be completely removed.
 - 2. Piping outside of building areas shall be completely removed.
- B. Excavate around manholes as required and use either procedure below:
 - 1. Manholes and structures outside of building areas: Remove frame and cover, cut and remove the top of an elevation of 2 feet (600 mm) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.
 - 2. Manholes and structures with building areas: Remove frame and cover and remove the entire structure and the base.
- C. Backfill to grade according to Division 31 Section 31 23 16.13, TRENCHING.
- D. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.10 PIPE SEPARATION

- A. Horizontal Separation - Water Mains and Sewers:
 - 1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
 - 2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:
 - a. Local conditions prevent a lateral separation of 10 feet (3 m); and

- b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.
3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches (600 mm) above the crown of gravity flow sewer or 48 inches (1200 mm) above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 24 inches (600 mm) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

3.11 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edges of underground manholes.

3.12 FIELD QUALITY CONTROL

- A. All systems shall be inspected and obtain the Owner's Representative's approval. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.
 1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- 4. Re-inspect and repeat procedure until results are satisfactory.
- C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - 1. Test plastic gravity sewer piping according to ASTM F1417.
 - 2. Test concrete gravity sewer piping according to ASTM C924.
 - 3. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.
 - 4. For force mains, perform testing after supports and anchors are installed. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
 - 5. Testing of Fiberglass Sewage Holding Tanks shall show no leakage during a 5 psi (35 kPa) air pressure test with 5:1 safety factor.
 - 6. Testing of Concrete Wet Well shall show no leakage with the wet well completely filled with water for a duration of 4 hours.

3.13 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 33 30 00

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Storm drainage piping.
2. Accessories.
3. Underground pipe markers.
4. Catch basins and plant area drains.
5. Cleanouts.
6. Bedding and cover materials.

B. Related Sections:

1. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.
2. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
3. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill required by this section.
4. Section 31 23 16.13 - Trenching: Execution requirements for trenching required by this section.
5. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.

1.3 UNIT PRICE - BASIS OF MEASUREMENT – NOT USED

1.4 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
5. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
6. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
7. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

8. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
10. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
11. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
12. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
13. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
14. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
16. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
17. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
18. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
19. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
20. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. PennDOT Publication 408, current edition.

D. PennDOT Publication 72M, RC Standards, current edition.

E. PennDOT Bulletin 15.

F. PADEP Erosion and Sediment Pollution Control Program Manual, dated March 2012 and all corrections.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures Requirements for submittals.

B. Submit drawings for layout of underground detention basins, including elevations of all inverts, and outlet control structures.

C. Product Data: Submit data indicating pipe, pipe accessories, reinforcement, and manufacturer

D. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

E. Manufacturer's Certificate: Certify Products meet or exceed PennDOT publication 408 requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations on record drawings.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with municipal and PennDOT Publication 408 standards.
- B. Comply with applicable portions of Conservation District regulations pertaining to storm sewage systems.
- C. Verify all existing storm utility inverts and finished grades prior to starting work. Excavate test pits and measure elevation of tie-in locations. Provide elevations to design engineer.

1.8 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.9 COORDINATION

- A. Coordinate the Work with termination of storm sewer connection outside building, trenching, connection to municipal sewer utility service.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

- A. Reinforced Concrete Pipe: ASTM C76, IV, bell and spigot ends, as shown on drawings.

1. Fittings: Reinforced concrete.
2. Joints: ASTM C443, rubber compression gasket.

- B. ADS N-12 HDPE pipes, as shown on drawings.

1. Per manufacturer's requirements. The pipes shall be manufactured in the U.S.A. by an approved ADS manufacturer.
2. The pipes shall be placed over the geotextile Mirafi 160N or approved equal, as specified on the Drawings.

- C. Plastic Piping (PVC):

- 1) Pipe:
 - a) Material: PVC.
 - b) Comply with ASTM D3034 and D2680, SDR 35 unless stated otherwise on project drawings.
 - c) Inside Nominal Diameter: as specified on project drawings.
 - d) Style: Bell and spigot with rubber-ring sealed gasket joint.
- 2) Fittings: PVC.
- 3) Joints:
 - a) Comply with ASTM F477.
 - b) Gaskets: Elastomeric.

- D. Plastic Piping (HDPE):

- 1) Pipe:

- a) Material: High Density Polyethylene Culvert Pipe, smooth interior. ADS N-12 or equivalent.
- b) Comply with AASHTO M294
- c) Inside Nominal Diameter: as specified on project drawings.
- d) Style: Polyethylene sleeve with gasket.

- E. Any deviation from the materials shown on the Drawings requires submission of a stormwater analysis, using the same methodologies and programs as the design, to prove the equivalent material exceeds the materials on the Drawings as well as submissions to all affected reviewing agencies to modifications to their permits. Absent of this information, the contractor is to pay the design professional for the necessary calculations to prove the materials exceed the designed material as well as for any changes to permits.

2.2 ACCESSORIES

- A. Filter Fabric: Non-biodegradable, non-woven, per drawings

2.3 CATCH BASINS, YARD DRAINS, AND CLEANOUTS

- A. Furnish materials in accordance with PennDOT Publication 408 standards for suppliers approved in Bulletin 15 Approved Construction Materials
- B. The Contractor shall provide precast inlets at the locations and to the dimensions and elevations shown on the drawings. The inlets shall be the type inlets indicated on the drawings and constructed as specified by the municipal standard construction details, PennDOT Standard Construction Details, and PennDOT RC-standards, latest edition, and as shown on the plans. Included shall be all necessary excavation, precast concrete sections, steps, gaskets, brick masonry, frame and grate, concrete low flow channels, backfilling and all necessary appurtenances for completion. Include all weepholes indicated on inlets to provide sub-surface drainage from adjoining areas. Where precast structures cannot be installed due to elevation limitations or utility conflicts, poured in place structures can be substituted.
- C. Provide polypropylene plastic steps conforming to ASTM D4141-95B with a ½" deformed reinforcing rod, Grade 60, conforming to ASTM A615.

2.4 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type as specified in Section 31 05 16 – Aggregates for Earthwork, and as shown on drawings.
- B. Cover: Fill Type as specified in Section 31 05 16 – Aggregates for Earthwork, and as shown on drawings.

- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type, as specified in Section 31 05 13 – Soils for Earthwork Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify trench cut; excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Perform complete site review and investigation, research public utility records, and verify existing utility locations. Contact utility-locating service for area where project is located.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with coarse aggregate lean concrete.
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 16.13 - Trenching for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, as shown on drawings.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Refer to Section 31 23 23 - Fill for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- B. Refer to Section 33 05 16.13 – Precast Concrete Utility Structures for manhole requirements.
- C. Install Work in accordance with municipal and PennDOT Publication 408 standards.

3.5 INSTALLATION - CATCH BASINS AND CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place Cast-In-Place Concrete base pad, with provision for storm sewer pipe end sections.
- C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

- D. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.
- F. Install Work in accordance with municipal and PennDOT Publication 408 standards

3.6 FIELD QUALITY CONTROL

- A. Request inspection prior to and immediately after placing aggregate cover over pipe.
- B. Contact Owner's Representative 48 hours prior to installation of Subsurface detention basins.
- C. When tests indicate work does not meet specified requirements, remove work, replace and retest.

3.7 PROTECTION OF FINISHED WORK

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
 - 1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
 - 2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION 33 41 00