

PROJECT MANUAL

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

IFB for Contract No. 600-19-21

MECHANICAL CONSTRUCTION

CONSULTANT: Architectural Innovations

Issued: April 12, 2021

Caster D. Binion Executive Director

Housing Authority of the City of Pittsburgh

Point of Contact: Kim.Detrick@hacp.org or 412-456-5116 Opt 1

Bids Due May 25, 2021 10:00 am

Procurement Dept. 100 Ross St. 2nd FL. Suite 200 Pittsburgh, PA 15219

Attn: Mr. Kim Detrick, Director of Procurement



Procurement Department 100 Ross Street, Suite 200 Pittsburgh, PA 15219 Phone: (412) 456-5116 Fax: (412) 456-5007 www.hacp.org

NOTICE TO PROSPECTIVE BIDDERS

April 12, 2021

INVITATION FOR BIDS (IFB)

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

The HOUSING AUTHORITY OF THE CITY OF PITTSBURGH will receive separate sealed bids for Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09 ; for the following contracts:

MECHANICAL CONSTRUCTION

The estimated values of the project per contract noted above are in the following ranges:

MECHANICAL CONSTRUCTION \$ 42,000.00 \$ 57,000.00

Bid documents will be available onApril 12, 2021. A Pre-Bid Conference will be held onApril 28, 2021 at3:00 pm, at The Northview Heights Officer Calvin M. Hall Public Safety Center

441 Mount Pleasant Road, Pittsburgh PA 15214. Building #75

A site visit of the property will be conducted thereafter. Bidders shall be prepared to review all aspects of the site necessary to prepare a bid. The last day for submission of written questions will be
<u>May 10, 2021</u> until <u>10:00 am</u> Bids will be received at the HACP Procurement
Department, 100 Ross Street – Suite 200 (2nd Floor), Pittsburgh, PA, 15219 until <u>10:00 am</u> on
<u>May 25, 2021</u>, at which time and place all bids will be publicly opened and read aloud.

The work must be substantially complete within 120 calendar days of the Notice to Proceed.

VIRTUAL PRE-BID CONFERENCE MEETING

A Pre-bid meeting will be conducted virtually on 04/28 at 10:15 am via the zoom link provided below. This pre-bid meeting serves in addition to the site visit listed above and does not replace the site visit. Prospective Bidders may call in via the computer or phone.

Join Zoom Meeting https://zoom.us/j/98291081513?pwd=SUtWb2RWbGw2SkRGSU8rVktUWWFLUT09 Meeting ID: 982 9108 1513 Passcode: 141599 One tap mobile +13126266799,,98291081513#,,,,*141599# US (Chicago) +19292056099,,98291081513#,,,,*141599# US (New York) Dial by your location +1 312 626 6799 US (Chicago) +1 929 205 6099 US (New York) Meeting ID: 982 9108 1513 Passcode: 141599 Find your local number: https://zoom.us/u/ahVOogCrR

PRE_BID SITE VISIT

The Pre-Bid Site visit will be held on 04/28/2021 from 3:00pm to 4:20pm. Site visits will be held in 20-minute blocks. The time blocks are as follows: 3:00-3:20pm, 3:20pm-3:40pm, 3:40pm-4:00pm, or 4:00-4:20pm on 04/28/2021. Please email morgan.block@hacp.org and kim.detrick@hacp.org with your selected time block for viewing the site. Time blocks will be filled on a first come first served basis. Only one vendor will be allowed to enter the building per time block.

Point of contact for the Housing Authority is Mr. Kim Detrick at (412) 456-5116 Opt 1.

TO VIEW AND OBTAIN DOCUMENTS

Bid Documents, including the Bid Forms, Project Manual, and Drawings, may be obtained from the Business Opportunities Section of the HACP website, <u>www.hacp.org</u>. Prospective Bidders may register as a vendor on the website and download the documents free of charge. Electronic versions of the Bid Documents may also be obtained in person, Monday through Friday 8:30 a.m. to 4:30 p.m. at the Housing Authority of the City of Pittsburgh's Procurement Department, located at 100 Ross Street, Suite 200, Pittsburgh, PA 15219.

HACP will also accept Online submission for this invitation of bid in addition to accepting submissions at our 100 Ross Street office. For respondents wishing to submit Online, please go to the following web address and upload the document: https://www.dropbox.com/request/fB301uRV6C26ARXznk1d

Please include your name and email address when prompted before submitting and upload all relevant attachments in the same document. Formatting for Online submission should be organized in the same manner as if submitted the information via CD or Flash drive. The title of the uploaded bid shall be as follows; [Full Company Name]_IFB#600-19-21. In the unlikely event that your bid is too large as a single file, add;_Part-1,_Part-2...etc to the end of the file.

AWARD OF CONTRACT (S):

It is the intention of the Authority to award a contract to the lowest responsive and responsible bidder.

All bids shall remain open for the period specified in the IFB, which in no case shall be less than sixty (60) calendar days from the bid opening.

All bids of \$10,000 or more must be accompanied by a negotiable bid guarantee that shall not be less than 5% of the amount of the bid. No bid guarantee is required for bids under \$10,000. In accordance with 2 CFR 200.318(h) formerly 24 CFR Section 85.36(b)(8), the Authority is permitted to make awards only to responsible bidders possessing the ability to perform successfully under the terms and conditions of the proposed contract. Prior to award of any contract, the Authority shall conduct a pre-contract survey. Consideration will be given to such matters as bidder integrity, compliance with public policy, record of past performance, and financial and technical resources.

All bids must include a completed and signed Form of Agreement (Form 00500) as part of the bid. If the bid is successful and approved by HACP Board of Commissioners (if applicable), HACP will also sign the Form of Agreement thus creating a binding contract.

The successful bidder will be required to furnish an assurance of completion (performance and payment bond) each equal to 100% of the contract price.

The Authority reserves the right to reject any or all bids or to waive any informality in the bidding.

EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

The Contractor will be required to comply with all applicable Equal Employment Opportunity requirements for Federally-Assisted Construction Contracts. The Contractor must insure that employees and applicants for employment are not discriminated against because of race, color, religion, sexual preference, handicap or national origin.

A. Section 3 Participation

The work to be performed under this contract is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C 1701u and with HUD's regulations set forth at 24 CFR Part 135 ("Section 3"). The purpose of Section 3 is to ensure that employment and other economic opportunities generated by HUD assistance shall be directed to low and very low-income per-sons, particularly persons who are recipients of HUD assistance for housing.

Please describe ways the Bidder will assist HACP to comply with HUD's Section 3 requirements for hiring HACP residents and/or local disadvantaged individuals and businesses by reviewing the Section 3 Clause and by completing **Document 00433 – Section 3 Form.**

Section 3 of the Housing and Urban Development Act of 1968, as amended (12 U.S.C. 1701, et seq.) (the "Act") requires the Housing Authority of the City of Pittsburgh to ensure that employment and other economic and business opportunities generated by financial assistance from the Department of Housing and Urban Development ("HUD"), to the greatest extent feasible, are directed to public housing residents and other low income persons, particularly recipients of government housing assistance, and business concerns that provide economic opportunities to low and very low income persons.

To comply with the Act HACP requires its contractors to provide equal employment opportunity to all employees and applicants for employment without regard to race, color, religion, sex, national origin, disability, veteran's or marital status, or economic status and to take affirmative action to ensure that both job applicants and existing employees are given fair and equal treatment.

The goal of this policy is to obtain a reasonable level of success in the recruitment, employment, and utilization of HACP residents and other eligible persons and/or businesses by contractors working on contracts partially or wholly funded with HUD monies. HACP shall examine and consider a contractor's potential for success in providing employment and business opportunities to those covered under Section 3 prior to acting on any proposed contract award. In response to any RFP, RFQ or IFB HACP will require submission of the Section 3 Opportunities Plan and roster of current employees, and certification that the bidder will comply with the requirements of Section 3 either by hiring Section 3 employees to directly perform under the contract or by committing a dollar amount to HACP's Section 3 program in an amount consistent with the chart below. Below are the HACP Section 3 Guidelines as listed in the HACP Section 3 Program Manual:

| TOTAL LABOR DOLLARS | RESIDENT LABOR AS A % OF |
|---|---|
| USE TOTAL CONTRACT | TOTAL LABOR |
| AMOUNT FOR SERVICE | A. DOLLARS |
| CONTRACTS | |
| Labor dollars \$25,000 but less than | 10% of the labor dollars |
| \$100,000 | |
| \$100,000, but less than \$200,000 | 9% of the labor dollars |
| At least \$200,000, but less than \$300,000 | 8% of the labor dollars |
| At least \$300,000, but less than \$400,000 | 7% of the labor dollars |
| At least \$400,000, but less than \$500,000 | 6% of the labor dollars |
| At least \$500,000, but less than \$1 million | 5% of the labor dollars |
| At least \$1 million, but less than \$2 million | 4% of the labor dollars |
| At least \$2 million, but less than \$4 million | 3% of the labor dollars |
| At least \$4 million, but less than \$7 million | 2% of the labor dollars |
| \$7 million or more | $\frac{1}{2}$ to 1 % of the labor dollars |

RESIDENT HIRING REQUIREMENTS / RESIDENT HIRING SCALE

**A copy of HACP's Section 3 Program Manual is available for download at <u>www.hacp.org</u>

A copy of HUD's Section 3 requirement is provided herein. If you have any questions regarding the Section 3 Requirements or would like to discuss goals and planning for Section 3 Requirements please contact Mr. Lloyd Wilson, Resident Employment Manager/Section 3 Coordinator, by e-mail at <u>lloyd.wilson@hacp.org</u> or by contacting him at the Housing Authority of the City of Pittsburgh, Resident Employment Program located at the Bedford Hope Center, 2305 Bedford Ave, Pittsburgh PA 15219, telephone (412) 395-3950, ext. 1048. Proposals must demonstrate how the Offeror intends to meet or exceed the Authority's Section 3 requirements. Proposals submitted without a Section 3 plan may be deemed nonresponsive. Also, please complete **Section 3 Opportunities Plan** and include with your proposal.

Any bid or proposal received from a contractor that does not contain a Section 3 Opportunities Plan or certification and back-up documentation acceptable to HACP shall be deemed nonresponsive by HACP.

B. MBE/WBE Participation Plan

HACP MBE and WBE Goals. It is the policy of HACP to ensure that Minority Business Enterprises (MBEs) and Women-owned Businesses (WBEs) are provided maximum opportunity to participate in contracts let by HACP. In accordance with Executive Order 11625, HACP has established a minimum threshold of eighteen percent (18%) of the total dollar amount for MBE utilization in this contract. HACP has established a seven percent (7%) minimum threshold for participation of WBEs, and, HACP strongly encourages and affirmatively promotes the use of MBEs and WBEs in all HACP contracts. For these purposes, an MBE is defined as "any legal entity other than a joint venture, organized to engage in commercial transactions, that is at least fifty-one percent (51%) owned and controlled by one or more minority group, which includes African-Americans, Hispanic-Americans, Native-Americans, and Asian-Americans. A WBE/MBE is defined as "any legal entity other than a joint venture, organized to engage in commercial transactions, that is at least fifty-one percent (51%) owned and controlled by other than a joint venture, organized to engage in commercial transactions, that is at least fifty-one percent (51%) owned and controlled by other than a joint venture, organized to engage in commercial transactions, that is at least fifty-one percent (51%) owned and controlled by other than a joint venture, organized to engage in commercial transactions, that is at least fifty-one percent (51%) owned and controlled by a female.

Bids or proposals submitted in response to this solicitation MUST include an MBE/WBE participation plan which, at a minimum demonstrates "Best Efforts" have been taken to achieve compliance with MBE/WBE goals. HACP's Procurement Policy defines "Best Efforts" in compliance with MBE/WBE goals to mean that the contractor must certify and document with its bid or proposal that it has contacted in writing at least ten (10) certified MBE and ten (10) certified WBE subcontractors to participate in the proposed contract with or lesser number if the contractor provides documentation that ten (10) certified MBE/WBE contractors could not be identified. Each contractor shall certify as to same under penalty of perjury and shall submit the back-up documentation with its bid or proposal. Any bid or proposal received from a contractor that does not contain such certification and back-up documentation acceptable to HACP may be deemed non-responsive by HACP.

If you have any questions regarding the HACP MBE/WBE goals please contact Mr. Kim Detrick, Director of Procurement/Chief Contracting Officer, by e-mail at <u>kim.detrick@hacp.org</u> or by contacting him at the Procurement Department, Housing Authority of the City of Pittsburgh, 100 Ross Street, Suite 200 Pittsburgh PA 15219, telephone (412) 456-5116 opt.1. Bids or proposals must demonstrate how the Offeror intends to meet or exceed these goals.

The Authority's Minority and Woman Business (MBE/WBE) participation goals are as follows:

-- MBE Goal: 18% -- WBE Goal: 7%

Additionally, please be advised that participation credit will be applied in accordance with the following classifications, as follows:

| Broker: | 10% of contract face value |
|---------------------------------|-----------------------------|
| Supplier: | 60% of contract face value |
| Bona Fide Contractor: | 100% of contract face value |
| All Professional Service Firms: | 100% of contract face value |

Vendor definitions for the above classifications are to be referenced in either the respective vendor MBE/WBE certifications or as defined in 49 CFR Part 26.

Please describe ways the Bidder will utilize MBE/WBE businesses to meet the goals above by completing **Document 00434 – MBE/WBE Solicitation & Commitment Record**.

Caster D. Binion Executive Director Housing Authority of the City of Pittsburgh



SPECIAL PROVISIONS

NOTICE TO ALL PROSPECTIVE BIDDERS

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

CONTRACT NO. <u>600-19-21</u>

Each successful bidder(s) shall be required to comply with the following special provisions:

A. Required Documents/Information

After bid opening and determination of the responsive and responsible bidder, but prior to Notice to Proceed each successful bidder for this project shall provide the following documents/information to HACP within ten (10) business days of receiving written notice thereof:

- (1) Insurance
- (2) Payment and Performance Bonds
- (3) Construction Schedule
- (4) Submittal Log and Corresponding Submittals

Please accept these special provisions by completing the information requested below:

| Signature of Authorized Officer: | Date: |
|----------------------------------|-------|
| Name of Contractor: | |
| Address: | |
| Telephone Number: | |

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

IFB CONTRACT NO. 600-19-21

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH DEVELOPMENT & MODERNIZATION DEPARTMENT 100 Ross Street, Suite 200 Pittsburgh, PA 15219 Phone: (412) 456-5020 Fax: (412) 456-5591

Issued: April 12, 2021

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Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP Contract No. 600-19-21

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Form of Agreement Contracting Officer Certification Performance Bond Payment Bond

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HACP CONTRACT NO. 600-19-21

INVITATION FOR BIDS LIST OF DOCUMENTS

The HOUSING AUTHORITY OF THE CITY OF PITTSBURGH will receive separate sealed bids for <u>Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09</u>, for the following contracts:

MECHANICAL CONSTRUCTION

A complete Invitation for Bids (IFB) consists of the following documents:

THE PROJECT MANUAL, dated _____ April 12, 2021 _____ consisting of:

Bidding Requirements, Contract Forms, Conditions of the Contract, Wage Determination, and the Specifications.

THE PROJECT DRAWINGS, as prepared by Architectural Innovations, dated 09/28/2020

THE BID PACKAGE, dated <u>April 12, 2021</u> consisting of a single three-ring binder containing:

Blank bid document forms to be completed by the bidder;

Divider tabs to separate the original bid documents from the copies;

A pre-printed, pre-addressed envelope in which to deliver the bid.

ADDENDA will be issued as required.

IDENTIFICATION OF OWNER

The Owner of this project is the Housing Authority of the City of Pittsburgh, a body corporate and politic and created pursuant to the "Housing Authorities Law," an Act passed by the 1937 session of the Legislature of the Commonwealth of Pennsylvania, P.L. 955, approved May 28, 1937, hereinafter variously called the "Housing Authority of the City of Pittsburgh" (HACP), "The Authority," the "Local Housing Authority" (LHA), the "Public Housing Authority" (PHA), or the "Public Housing Authority/Indian Housing Authority" (PHA/IHA).

Caster D. Binion Executive Director Housing Authority of the City of Pittsburgh

James D. Harris, Esquire General Counsel Housing Authority of the City of Pittsburgh

Kim Detrick Director of Procurement Housing Authority of the City of Pittsburgh

U.S. Department of Housing and Urban Development

Office of Public and Indian Housing

Instructions to Bidders for Contracts Public and Indian Housing Programs

Instructions to Bidders for Contracts

Public and Indian Housing Programs

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1. Bid Preparation and Submission

(a) Bidders are expected to examine the specifications, drawings, all instructions, and, if applicable, the construction site (see also the contract clause entitled **Site Investigation and Conditions Affect-***ing the Work* of the *General Conditions of the Contract for Construc-tion*). Failure to do so will be at the bidders' risk.

(b) All bids must be submitted on the forms provided by the Public Housing Agency/Indian Housing Authority (PHA/IHA). Bidders shall furnish all the information required by the solicitation. Bids must be signed and the bidder's name typed or printed on the bid sheet and each continuation sheet which requires the entry of information by the bidder. Erasures or other changes must be initialed by the person signing the bid. Bids signed by an agent shall be accompanied by evidence of that agent's authority. (Bidders should retain a copy of their bid for their records.)

(c) Bidders must submit as part of their bid a completed form HUD-5369-A, "Representations, Certifications, and Other Statements of Bidders."

(d) All bid documents shall be sealed in an envelope which shall be clearly marked with the words "Bid Documents," the Invitation for Bids (IFB) number, any project or other identifying number, the bidder's name, and the date and time for receipt of bids.

(e) If this solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "No Bid" in the space provided for any item on which no price is submitted.

(f) Unless expressly authorized elsewhere in this solicitation, alternate bids will not be considered.

(g) Unless expressly authorized elsewhere in this solicitation, bids submitted by telegraph or facsimile (fax) machines will not be considered.

(h) If the proposed contract is for a Mutual Help project (as described in 24 CFR Part 905, Subpart E) that involves Mutual Help contributions of work, material, or equipment, supplemental information regarding the bid advertisement is provided as an attachment to this solicitation.

2. Explanations and Interpretations to Prospective Bidders

(a) Any prospective bidder desiring an explanation or interpretation of the solicitation, specifications, drawings, etc., must request it at least 7 days before the scheduled time for bid opening. Requests may be oral or written. Oral requests must be confirmed in writing. The only oral clarifications that will be provided will be those clearly related to solicitation procedures, i.e., not substantive technical information. No other oral explanation or interpretation will be provided. Any information given a prospective bidder concerning this solicitation will be furnished promptly to all other prospective bidders as a written amendment to the solicitation, if that information is necessary in submitting bids, or if the lack of it would be prejudicial to other prospective bidders.

(b) Any information obtained by, or provided to, a bidder other than by formal amendment to the solicitation shall not constitute a change to the solicitation.

3. Amendments to Invitations for Bids

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date on the bid form, or (3) by letter, telegram, or facsimile, if those methods are authorized in the solicitation. The PHA/IHA must receive acknowledgement by the time and at the place specified for receipt of bids. Bids which fail to acknowledge the bidder's receipt of any amendment will result in the rejection of the bid if the amendment(s) contained information which substantively changed the PHA's/IHA's requirements.

(c) Amendments will be on file in the offices of the PHA/IHA and the Architect at least 7 days before bid opening.

4. Responsibility of Prospective Contractor

(a) The PHA/IHA will award contracts only to responsible prospective contractors who have the ability to perform successfully under the terms and conditions of the proposed contract. In determining the responsibility of a bidder, the PHA/IHA will consider such matters as the bidder's:

- (1) Integrity;
- (2) Compliance with public policy;
- (3) Record of past performance; and
- (4) Financial and technical resources (including construction and technical equipment).

(b) Before a bid is considered for award, the bidder may be requested by the PHA/IHA to submit a statement or other documentation regarding any of the items in paragraph (a) above. Failure by the bidder to provide such additional information shall render the bidder nonresponsible and ineligible for award.

5. Late Submissions, Modifications, and Withdrawal of Bids

(a) Any bid received at the place designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it:

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for receipt of offers (e.g., an offer submitted in response to a solicitation requiring receipt of offers by the 20th of the month must have been mailed by the 15th);

(2) Was sent by mail, or if authorized by the solicitation, was sent by telegram or via facsimile, and it is determined by the PHA/IHA that the late receipt was due solely to mishandling by the PHA/IHA after receipt at the PHA/IHA; or

(3) Was sent by U.S. Postal Service Express Mail Next Day Service - Post Office to Addressee, not later than 5:00 p.m. at the place of mailing two working days prior to the date specified for receipt of proposals. The term "working days" excludes weekends and observed holidays.

(b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.

(c) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date or the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerk to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(d) The only acceptable evidence to establish the time of receipt at the PHA/IHA is the time/date stamp of PHA/IHA on the proposal wrapper or other documentary evidence of receipt maintained by the PHA/IHA.

(e) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on both the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph (c) of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's eye postmark on both the receipt and Failure by a bidder to acknowledge receipt of the envelope or wrapper.

(f) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the PHA/IHA will be considered at any time it is received and may be accepted.

(g) Bids may be withdrawn by written notice, or if authorized by this solicitation, by telegram (including mailgram) or facsimile machine transmission received at any time before the exact time set for opening of bids; provided that written confirmation of telegraphic or facsimile withdrawals over the signature of the bidder is mailed and postmarked prior to the specified bid opening time. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for opening of bids, the identity of the person requesting withdrawal is established and the person signs a receipt for the bid.

6. Bid Opening

All bids received by the date and time of receipt specified in the solicitation will be publicly opened and read. The time and place of opening will be as specified in the solicitation. Bidders and other interested persons may be present.

7. Service of Protest

(a) Definitions. As used in this provision:

"Interested party" means an actual or prospective bidder whose direct economic interest would be affected by the award of the contract.

"Protest" means a written objection by an interested party to this solicitation or to a proposed or actual award of a contract pursuant to this solicitation.

(b) Protests shall be served on the Contracting Officer by obtaining written and dated acknowledgement from —

Contracting Officer Legal Department Housing Authority of the City of Pittsburgh 200 Ross Street, 7th Floor Pittsburgh, PA 15219

[Contracting Officer designate the official or location where a protest may be served on the Contracting Officer]

(c) All protests shall be resolved in accordance with the PHA's/ IHA's protest policy and procedures, copies of which are maintained at the PHA/IHA.

8. Contract Award

(a) The PHA/IHA will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the PHA/IHA considering only price and any price-related factors specified in the solicitation.

(b) If the apparent low bid received in response to this solicitation exceeds the PHA's/IHA's available funding for the proposed contract work, the PHA/IHA may either accept separately priced items (see 8(e) below) or use the following procedure to determine contract award. The PHA/IHA shall apply in turn to each bid (proceeding in order from the apparent low bid to the high bid) each of the separately priced bid deductible items, if any, in their priority order set forth in this solicitation. If upon the application of the first deductible item to all initial bids, a new low bid is within the PHA's/IHA's available funding, then award shall be made to that bidder. If no bid is within the available funding amount, then the PHA/IHA shall apply the second deductible item. The PHA/IHA shall continue this process until an evaluated low bid, if any, is within the PHA's/IHA's available funding. If upon the application of all deductibles, no bid is within the PHA's/IHA's available funding, or if the solicitation does not request separately priced deductibles, the PHA/IHA shall follow its written policy and procedures in making any award under this solicitation.

(c) In the case of tie low bids, award shall be made in accordance with the PHA's/IHA's written policy and procedures.

(d) The PHA/IHA may reject any and all bids, accept other than the lowest bid (e.g., the apparent low bid is unreasonably low), and waive informalities or minor irregularities in bids received, in accordance with the PHA's/IHA's written policy and procedures.

(e) Unless precluded elsewhere in the solicitation, the PHA/IHA may accept any item or combination of items bid.

(f) The PHA/IHA may reject any bid as nonresponsive if it is materially unbalanced as to the prices for the various items of work to be performed. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

(g) A written award shall be furnished to the successful bidder within the period for acceptance specified in the bid and shall result in a binding contract without further action by either party.

9. Bid Guarantee (applicable to construction and equipment contracts exceeding \$25,000)

All bids must be accompanied by a negotiable bid guarantee which shall not be less than five percent (5%) of the amount of the bid. The bid guarantee may be a certified check, bank draft, U.S. Government Bonds at par value, or a bid bond secured by a surety company acceptable to the U.S. Government and authorized to do business in the state where the work is to be performed. In the case where the work under the contract will be performed on an Indian reservation area, the bid guarantee may also be an irrevocable Letter of Credit (see provision 10, Assurance of Completion, below). Certified checks and bank drafts must be made payable to the order of the PHA/IHA. The bid guarantee shall insure the execution of the contract and the furnishing of a method of assurance of completion by the successful bidder as required by the solicitation. Failure to submit a bid guarantee with the bid shall result in the rejection of the bid. Bid guarantees submitted by unsuccessful bidders will be returned as soon as practicable after bid opening.

10. Assurance of Completion

(a) Unless otherwise provided in State law, the successful bidder shall furnish an assurance of completion prior to the execution of any contract under this solicitation. This assurance may be [Contracting Officer check applicable items] —

[X] (1) a performance and payment bond in a penal sum of 100 percent of the contract price; or, as may be required or permitted by State law;

[] (2) separate performance and payment bonds, each for 50 percent or more of the contract price;

[] (3) a 20 percent cash escrow;

[] (4) a 25 percent irrevocable letter of credit; or,

[] (5) an irrevocable letter of credit for 10 percent of the total contract price with a monitoring and disbursements agreement with the IHA (applicable only to contracts awarded by an IHA under the Indian Housing Program).

(b) Bonds must be obtained from guarantee or surety companies acceptable to the U.S. Government and authorized to do business in the state where the work is to be performed. Individual sureties will not be considered. U.S. Treasury Circular Number 570, published annually in the Federal Register, lists companies approved to act as sureties on bonds securing Government contracts, the maximum underwriting limits on each contract bonded, and the States in which the company is licensed to do business. Use of companies listed in this circular is mandatory. Copies of the circular may be downloaded on the U.S. Department of Treasury website http:// www.fms.treas.gov/c570/index.html, or ordered for a minimum fee by contacting the Government Printing Office at (202) 512-2168.

(c) Each bond shall clearly state the rate of premium and the total amount of premium charged. The current power of attorney for the person who signs for the surety company must be attached to the bond. The effective date of the power of attorney shall not precede the date of the bond. The effective date of the bond shall be on or after the execution date of the contract.

(d) Failure by the successful bidder to obtain the required assurance of completion within the time specified, or within such extended period as the PHA/IHA may grant based upon reasons determined adequate by the PHA/IHA, shall render the bidder ineligible for award. The PHA/IHA may then either award the contract to the next lowest responsible bidder or solicit new bids. The PHA/IHA may retain the ineligible bidder's bid guarantee.

11. Preconstruction Conference (applicable to construction contracts)

After award of a contract under this solicitation and prior to the start of work, the successful bidder will be required to attend a preconstruction conference with representatives of the PHA/IHA and its architect/engineer, and other interested parties convened by the PHA/IHA. The conference will serve to acquaint the participants with the general plan of the construction operation and all other requirements of the contract (e.g., Equal Employment Opportunity, Labor Standards). The PHA/IHA will provide the successful bidder with the date, time, and place of the conference.

12. Indian Preference Requirements (applicable only if this solicitation is for a contract to be performed on a project for an Indian Housing Authority)

(a) HUD has determined that the contract awarded under this solicitation is subject to the requirements of section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e(b)). Section 7(b) requires that any contract or subcontract entered into for the benefit of Indians shall require that, to the greatest extent feasible

(1) Preferences and opportunities for training and employment (other than core crew positions; see paragraph (h) below) in connection with the administration of such contracts or subcontracts be given to qualified "Indians." The Act defines "Indians" to mean persons who are members of an Indian tribe and defines "Indian tribe" to mean any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act, which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; and,

(2) Preference in the award of contracts or subcontracts in connection with the administration of contracts be given to Indian organizations and to Indian-owned economic enterprises, as defined in section 3 of the Indian Financing Act of 1974 (25 U.S.C. 1452). That Act defines "economic enterprise" to mean any Indianowned commercial, industrial, or business activity established or organized for the purpose of profit, except that the Indian ownership must constitute not less than 51 percent of the enterprise; "Indian organization" to mean the governing body of any Indian tribe or entity established or recognized by such governing body; "Indian" to mean any person who is a member of any tribe, band, group, pueblo, or community which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs and any "Native" as defined in the Alaska Native Claims Settlement Act: and Indian "tribe" to mean any Indian tribe, band, group, pueblo, or community including Native villages and Native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs.

(b) (1) The successful Contractor under this solicitation shall comply with the requirements of this provision in awarding all subcontracts under the contract and in providing training and employment opportunities.

(2) A finding by the IHA that the contractor, either (i) awarded a subcontract without using the procedure required by the IHA, (ii) falsely represented that subcontracts would be awarded to Indian enterprises or organizations; or, (iii) failed to comply with the contractor's employment and training preference bid statement shall be grounds for termination of the contract or for the assessment of penalties or other remedies.

(c) If specified elsewhere in this solicitation, the IHA may restrict the solicitation to qualified Indian-owned enterprises and Indian organizations. If two or more (or a greater number as specified elsewhere in the solicitation) qualified Indian-owned enterprises or organizations submit responsive bids, award shall be made to the qualified enterprise or organization with the lowest responsive bid. If fewer than the minimum required number of qualified Indian-owned enterprises or organizations submit responsive bids, the IHA shall reject all bids and readvertise the solicitation in accordance with paragraph (d) below.

(d) If the IHA prefers not to restrict the solicitation as described in paragraph (c) above, or if after having restricted a solicitation an insufficient number of qualified Indian enterprises or organizations submit bids, the IHA may advertise for bids from non-Indian as well as Indian-owned enterprises and Indian organizations. Award shall be made to the qualified Indian enterprise or organization with the lowest responsive bid if that bid is -

(1) Within the maximum HUD-approved budget amount established for the specific project or activity for which bids are being solicited; and

(2) No more than the percentage specified in 24 CFR 905.175(c) higher than the total bid price of the lowest responsive bid from any qualified bidder. If no responsive bid by a qualified Indian-owned economic enterprise or organization is within the stated range of the total bid price of the lowest responsive bid from any qualified enterprise, award shall be made to the bidder with the lowest bid.

(e) Bidders seeking to qualify for preference in contracting or subcontracting shall submit proof of Indian ownership with their bids. Proof of Indian ownership shall include but not be limited to:

(1) Certification by a tribe or other evidence that the bidder is an Indian. The IHA shall accept the certification of a tribe that an individual is a member.

(2) Evidence such as stock ownership, structure, management, control, financing and salary or profit sharing arrangements of the enterprise.

(f) (1) All bidders must submit with their bids a statement describing how they will provide Indian preference in the award of subcontracts. The specific requirements of that statement and the factors to used by the IHA in determining the statement's adequacy are included as an attachment to this solicitation. Any bid that fails to include the required statement shall be rejected as nonresponsive. The IHA may require that comparable statements be provided by subcontractors to the successful Contractor, and may require the Contractor to reject any bid or proposal by a subcontractor that fails to include the statement.

(2) Bidders and prospective subcontractors shall submit a certification (supported by credible evidence) to the IHA in any instance where the bidder or subcontractor believes it is infeasible to provide Indian preference in subcontracting. The acceptance or rejection by the IHA of the certification shall be final. Rejection shall disqualify the bid from further consideration.

(g) All bidders must submit with their bids a statement detailing their employment and training opportunities and their plans to provide preference to Indians in implementing the contract; and the number or percentage of Indians anticipated to be employed and trained. Comparable statements from all proposed subcontractors must be submitted. The criteria to be used by the IHA in determining the statement(s)'s adequacy are included as an attachment to this solicitation. Any bid that fails to include the required statement(s), or that includes a statement that does not meet minimum standards required by the IHA shall be rejected as nonresponsive.

(h) Core crew employees. A core crew employee is an individual who is a bona fide employee of the contractor at the time the bid is submitted; or an individual who was not employed by the bidder at the time the bid was submitted, but who is regularly employed by the bidder in a supervisory or other key skilled position when work is available. Bidders shall submit with their bids a list of all core crew employees.

(i) Preference in contracting, subcontracting, employment, and training shall apply not only on-site, on the reservation, or within the IHA's jurisdiction, but also to contracts with firms that operate outside these areas (e.g., employment in modular or manufactured housing construction facilities).

(j) Bidders should contact the IHA to determine if any additional local preference requirements are applicable to this solicitation.

(k) The IHA [] does [X] does not [Contracting Officer check applicable box] maintain lists of Indian-owned economic enterprises and Indian organizations by specialty (e.g., plumbing, electrical, foundations), which are available to bidders to assist them in meeting their responsibility to provide preference in connection with the administration of contracts and subcontracts.

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP CONTRACT NO. <u>600-19-21</u>

NOTICE OF PRE-BID CONFERENCE

A Pre-Bid Conference will be held on April 28, 2021

- A Pre-Bid Conference will be held on <u>April 28, 2021 at</u> 3:00 pm, at the The Northview Heights Officer Calvin M. Hall Public Safety Center 441 Mount Pleasant Road, Pittsburgh PA 15214. Building #75. A site
 - visit of the property will be conducted thereafter. Bidders shall be prepared to review all aspects of the site necessary to prepare a bid.
- Representatives of the Authority, the engineer and other interested parties will be in attendance.

All bidders are urged to attend.

- Bidders are responsible for examining the construction site. (Refer to "Instructions to Bidders for Contracts," Document HUD 5369, Clause 1, "Bid Preparation and Submission.") Notwithstanding the above, lack of attendance will not be a basis for rejecting a bid.
- Bidders are urged to examine the drawings and specifications prior to the Pre-Bid Conference.
- Nothing at the Pre-Bid Conference will change the terms of the IFB unless a subsequent Addendum is issued. (Refer to "Instructions to Bidders for Contracts," Document HUD 5369, Clause 2, "Explanations and Interpretations to Prospective Bidders.")

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP CONTRACT NO. 600-19-21

PROJECT SCHEDULE

No Later Than April 12, 2021

April 28, 2021 3:00 pm

<u>May 10, 2021</u> 10:00 am

<u>May 25, 2021</u> 10:00 am

June 24, 2021 (estimated)

July 2, 2021 (estimated)

July 15, 2021 (estimated)

July 29, 2021 (estimated)

<u>120</u> calendar days from effective date of Notice to Proceed Invitation for Bids issued

Pre-Bid Conference (Followed by Site Visit)

Last day to submit written questions

Bids due

Notice of Award

Execution of Contracts

Pre-Construction Conference

Construction Start

All work required under this contract shall be complete

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP CONTRACT NO. <u>600-19-21</u>

SCOPE OF WORK FOR MECHANICAL CONSTRUCTION

The Contract for Mechanical Construction shall consist of the following component parts:

1. THE AGREEMENT

(Bound in the Project Manual)

| THE BID | Document 00340 - Scope of Work for Mechanical Construction Document 00341 - Form of Bid for Mechanical Construction |
|-------------|--|
| THE FORM OF | Document 00500 - Form of Agreement |
| AGREEMENT | Document 00590 - Contracting Officer Certification |
| CONDITIONS | Document HUD - 5370 General Conditions |
| OF THE | HACP Document - Supplemental General Conditions |
| CONTRACT | Document 00830 - Wage Determination Schedule |

2. PRIMARY SPECIFICATIONS FOR THE MECHANICAL CONSTRUCTION CONTRACT (Bound in the Project Manual)

All Work contained in the Primary Specifications listed below is the Work of the Contractor for this Mechanical Construction Contract unless specifically indicated otherwise.

Any Reference in the Primary Specifications to the "Contractor," the "Prime Contractor," or the "Mechanical Contractor" shall be interpreted as meaning the Contractor for this Mechanical Construction Contract.

The Mechanical Contractor shall coordinate the schedule and activities of work performed under this contract with that of those contracts identified as (G)-General, (E)-Electrical, and (P)-Plumbing.

It is the contractual responsibility of the Contractor for Mechanical Construction to familiarize himself with the work of the other prime contractors so that the Project as a whole can proceed in an orderly fashion. Failure to familiarize work by other trades would not be an excuse for corrective measures at no cost to the City of Pittsburgh Housing Authority.

For example, the Mechanical Contractor shall coordinate installation of mechanical construction work with the requirements of the Electrical, Plumbing, and General Contractors.

Reference Standard for Incidental Work: Incidental work, as used in this paragraph, is work which is not a basic part of other Prime Contracts but which is required by reference.

For example, the General Contractor is required by his Primary Specifications to install and repair all general work. In the event that the Plumbing Contractor disturbs the general work, the patching, repair shall be done and follow the same Specification requirements of the appropriate Specification Section by the Plumbing Contractor even if that specification section may not be part of the Plumbing Contractor's Primary Specification. The same applies to all trades where incidental work occurs.

TECHNICAL SPECIFICATIONS MAY BE FOUND AT PART FOUR OF THE PROJECT MANUAL

PLEASE ALSO REFER TO DRAWINGS

3. **PRIMARY DRAWINGS FOR THE MECHANICAL CONSTRUCTION CONTRACT** (Contained in the set of Project Drawings issued simultaneously with this Project Manual)

All Work contained in the Primary Drawings listed below is the Work of this Contractor unless specifically indicated otherwise.

Any Reference to the "Contractor," the "Prime Contractor," or the "Mechanical Contractor" shall be interpreted as meaning the Contractor for this Mechanical Construction Contract.

The Primary Drawings for this contract consist of all <u>Architectural Innovations</u> construction documents drawings, dated <u>09/28/2020</u> and specifications contained in this project manual.

In case of drawing conflict with specifications, it is understood that the specification shall supersede the drawings.

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP Contract No. 600-19-21

FORM OF BID

MECHANICAL CONSTRUCTION

Contract No.: 600-19-21

| TO: | HOUSING AUTHORITY | BIDDER: | | |
|-----|--------------------------------------|---------|--------------------|--|
| | CITY OF PITTSBURGH | | (Bidder Name) | |
| | (Hereinafter called the "Authority") | | | |
| | 100 Ross Street, Suite 200 | | (Business Address) | |
| | Pittsburgh, PA 15219 | | | |
| | | | | |
| | | | | |

(Telephone)

- 1. The undersigned Bidder, having visited the site, having become familiar with local conditions affecting the cost of the work, **including all City of Pittsburgh current code requirements**, and having become familiar with the Invitation for Bids (the IFB) issued by the Authority, which consists of the following:
 - Project Manual, dated <u>April 12, 2021</u> containing Bidding Requirements, Contract Forms, Conditions of the Contract, and Specifications
 - Project Drawings, dated 09/28/2020
 - · Addenda (if any) as enumerated in this Form of Bid

hereby proposes to provide all supervision, technical personnel, labor, materials, machinery, tools, appurtenances, equipment and services required to construct and complete the Mechanical Construction Work as described in Document 00340 "Scope of Work for Mechanical Construction" and as indicated in the Drawings and Specifications, for the following Firm Fixed Price:

| | Dollars (\$) |
|-----------------------------|-------------------------------|
| (Insert Bid Price in words) | (Insert Bid Price in Figures) |

2. Bid security [] is [] is not submitted with this bid. *(Check one)*

Bid Security is in amount of:

% of the bid OR

_____Dollars (\$_____

)

Bid Security is in the form of:

- []Certified Check[]Bank Draft[]U.S. Govt. Bond[]Bid Bond (Document 00410)
- 3. The Bidder hereby acknowledges receipt of the following Addenda, if any, as issued by the Authority:

Total number of Addenda _____ (if none, so state)

| Addendum No. | _dated | Addendum No. | dated |
|--------------|--------|--------------|-------|
| Addendum No. | dated | Addendum No | dated |
| Addendum No. | dated | Addendum No | dated |
| Addendum No | dated | Addendum No | dated |
| Addendum No. | dated | Addendum No | dated |
| Addendum No | dated | Addendum No. | dated |

- 4. The Bidder attaches hereto the Special Provisions (Document 00021);
- 5. The Bidder attaches hereto the Statement of Bidder's Qualifications (Document 00420);
- 6. The Bidder attaches hereto the Section 3 Opportunities Plan (Document 00433), MBE/WBE Solicitation and Commitment Record (Document 00434), Bidder Manpower Plan (Document 00435), and Previous Related Experience (Document 00436);
- 7. The Bidder attaches hereto the Bidder's Representations, Certifications and Other Statements of Bidders (Document HUD 5369-A), Previous Participation Certificate (Document HUD-2530);
- 8. The Bidder attaches hereto the Bidder's Special Provisions Notice to All Prospective Bidders (Document 00437), Non-Collusion Affidavit (Document 00485);
- 9. The Bidder attaches hereto the completed Form of Agreement (Document 00500);
- 10. The Bidder attaches hereto the Supplemental General Conditions (HACP Document).

SHEET - FB-I

(To be used when the Bidder is an individual doing business as a Sole Proprietorship.)

THE BIDDER CERTIFIES THAT THE BIDDER IS:

[] An individual doing business in his/her own name
 [] An individual doing business under a fictitious or assumed name (Complete Proprietorship Fictitious Name Disclosure below)

SIGNED, SEALED AND DELIVERED

| this | | day of | 20 | · | |
|---------|---|-------------------------|-----------|-------------------------|--|
| Witness | ſ | (Printed or Typed Name) | Principal | (Printed or Typed Name) | |
| | Ì | (Signature and Date) | <u>۱</u> | (Signature and Date) | |

PROPRIETORSHIP FICTITIOUS NAME DISCLOSURE

(To be used when the Bidder is an individual doing business under a fictitious or assumed name.)

| | is an individual trading under a fictitious or |
|--|---|
| (Proprietor's Name) | |
| assumed name of | and [] has [] has not registered under |
| (Fictitious or Assumed Name Use | ed as Bidder's Name) (Check one) |
| the Fictitious Names Act of Pennsylvania, namely | w the Act of May 24, 1945 PI, 967, as amended 54 PS sec 281.1 |

the Fictitious Names Act of Pennsylvania, namely the Act of May 24, 1945, P.L.967, as amended, 54 P.S. sec. 281.1 et seq.

{

Principal

Witness

{

(Printed or Typed Name)

(Printed or Typed Name)

(Signature and Date)

(Signature and Date)

PARTNERSHIP SIGNATURE PAGE

(To be used when the Bidder is an individual doing business as a Partnership.)

THE BIDDER CERTIFIES THAT THE BIDDER IS:

[] A General Partnership (Attach completed Sheet FB-P-3)

- [] Doing business under Partnership Name
- [] Doing business under a fictitious or assumed name (Complete Partnership Fictitious Name Disclosure Sheet FB-P-2)
- [] A Limited Partnership (Attach completed Sheet FB-P-3)
 - [] Doing business under Partnership Name
 - [] Doing business under a fictitious or assumed name (Complete Partnership Fictitious Name Disclosure Sheet FB-P-2)

SIGNED, SEALED AND DELIVERED

| this | | day of | 20 | | |
|---------|---|-------------------------|-----------|---|-------------------------|
| Witness | | (Printed or Typed Name) | Partner * | | (Printed or Typed Name) |
| | { | (Signature and Date) | | { | (Signature and Date) |
| Witness | { | (Printed or Typed Name) | Partner * | { | (Printed or Typed Name) |
| | C | (Signature and Date) | | C | (Signature and Date) |

* If the Bidder is a partnership, the Bid and Contract must be signed in the name of the partnership by at least two general partners, and the names and addresses of all the partners must be listed on the certificate on Sheet FB-P-3.

PARTNERSHIP FICTITIOUS NAME DISCLOSURE

| (Te | be used when | n the Bidde | r is a partner | ship doing | business under | a fictitious of | r assumed name., |
|-----|--------------|-------------|----------------|------------|----------------|-----------------|------------------|
| | | | | | | | |

| | is a partnership trading under a fictitious or | |
|---|---|----|
| (Partnership's Name) | | |
| assumed name of (Fictitious or Assumed Name | and [] has [] has not registered under (Check one) | |
| the Fictitious Names Act of Pennsylvania, na seq. | mely the Act of May 24, 1945, P.L.967, as amended, 54 P.S.sec.281.1 | et |
| (Printed or Typed Name) Witness | (Printed or Typed Name) Partner* | |
| { | { | |

(Signature and Date)

(Signature and Date)

SHEET FB-P-2

PARTNERSHIP CERTIFICATE

(To be used when the Bidder is a partnership.)

| I, as partner of | |
|---------------------------------------|---|
| (Name of Partr | iership) |
| certify that the following are the na | ames and addresses of all the partners of said partnership. |
| | |
| Name: | Name: |
| Address: | Address: |
| City: | City: |
| Name: | Name: |
| Address: | Address: |
| City: | City: |
| Name: | Name: |
| Address: | Address: |
| City: | City: |
| Name: | Name: |
| Address: | Address: |
| City: | City: |
| | |

(Use additional sheets as required.)

| | | (Printed or Typed Name) | | | (Printed or Typed Name) |
|---------|---|-------------------------|----------|---|-------------------------|
| Witness | | (Frined or Typed Nume) | Partner* | | (Frinted of Typed Name) |
| | { | | | { | |
| | | (Signature and Date) | | | (Signature and Date) |

CORPORATION SIGNATURE PAGE

(To be used when the bidder is a corporation.)

THE BIDDER CERTIFIES THAT THE BIDDER IS:

[] A corporation doing business in its own name

[] A corporation doing business under a fictitious or assumed name (Complete Corporation Fictitious Name Disclosure FB-C-2)

SIGNED, SEALED AND DELIVERED

| this | day of | 20 | · | |
|-----------------|-------------------------|---------------------|------|-------------------------|
| (CORPC SEAL) | DRATE | | | (Corporate Name) |
| | | | | |
| | (Printed or Typed Name) | | | (Printed or Typed Name) |
| Witness { | | President V.P.** | { | |
| | (Signature and Date) | | (Sig | nature and Date) |
| | (Corporate Title) | | | (Corporate Title) |

** If the bidder is a corporation, the Bid and the Contract must be executed in the Corporation's correct corporate name by its President or Vice President and attested to by its Secretary or Assistant Secretary or Treasurer or Assistant Treasurer, and the Certification of Corporate Principal (Doc. 00625) must be executed by the Secretary or Assistant Secretary.

CORPORATION FICTITIOUS NAME DISCLOSURE

| | | is a | corporation trading under a fictitious or | |
|------------------------|-----------------------------|-----------------------------|---|---------|
| (Corporation's | Name) | | | |
| assumed nan | | Name Used as Bidder's Name) | and [] has [] has not registered under (Check one) | |
| the Fictitious seq. | s Names Act of Pennsylvania | , namely the Act of May | 24, 1945, P.L.967, as amended, 54 P.S.sec.2 | 81.1 et |
| Witness | (Printed or Typed Name) | President | (Printed or Typed Name) | |

(To be used when the Bidder is a corporation doing business under a fictitious or assumed name.)

(Printed or Typed Name) (Signature and Date) (Signature and Date)

** If the bidder is a corporation, the Bid and the Contract must be executed in the Corporation's correct corporate name by its President or Vice President and attested to by its Secretary or Assistant Secretary or Treasurer or Assistant Treasurer, and the Certification of Corporate Principal (Doc. 00625) must be executed by the Secretary or Assistant Secretary.

SHEET FB-C-2

CORPORATION CERTIFICATE

SHEET FB-C-3

(To be used when the bidder is a corporation)

| | is a corporation o | rganized and existing |
|--|---|-------------------------------------|
| (Corporate name used as Bidder name) | | |
| under the laws of the state of | with its principa | al place of business at: |
| (Street Address) | ,, (City) | (State) |
| and, if a non-Pennsylvania corporation [] business in Pennsylvania as required by the as amended, 15 P.S. sec.2005 et seq. | | |
| I, | , certify that I am the [] Secretary [] . | Assistant Secretary of the |
| Corporation named a Bidder herein; that | | who signed |
| this Bid on behalf of the Corporation was the | en(<i>President/V.P.</i>) ** | _ of said Corporation that |
| I know his signature and his signature ther behalf of said Corporation by authority of its | | duly signed, sealed and attested in |

(CORPORATE SEAL)

(Signature and Date)

** If the bidder is a corporation, the Bid and the Contract must be executed in the Corporation's correct corporate name by its President or Vice President and its Secretary or Assistant Secretary or Treasurer or Assistant Treasurer, and the above Certificate must be executed by the Secretary or Assistant Secretary

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we,

| , | as Principal, | and |
|--|-------------------|---------|
| (Insert name and address of Bidder exactly as it appears on Form of Bid) | _ | |
| , as S | ureties, are | |
| held and firmly bound unto the Housing Authority of the City of Pittsburgh, its certain attorney, (the Obligee, hereinafter called the "Authority") in the penal sum of | successors, or as | ssigns |
| Dollars (\$ |) | |
| lawful money of the United States, for the payment of which sum well and truly to be made, w heirs, personal representatives, successors, and assigns, jointly and severally, firmly by these prese | | s, our |
| THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas, the Principal simu the Authority the accompanying bid, dated | ıltaneously subn | nits to |
| , 20, the "Bid"), for constr | uction of | |
| (Insert date of bid) | | |
| | | |

(Insert name of project exactly as it appears on Form of Bid) pursuant to specifications, drawings and other related documents constituting the Invitation for Bids (the "IFB").

NOW, THEREFORE, if the Principal shall not withdraw said bid within the period specified therein after the opening of the same, or, if no period be specified, within sixty (60) days after the said opening, and shall within the period specified therefore, or, if no period be specified within ten (10) days after the prescribed forms are presented to him for signature, enter into a written contract with the Authority in accordance with the bid as accepted, and give bonds with good and sufficient surety or sureties, as may be required for the faithful performance and proper fulfillment of such contract and for the payment of labor and materialmen or in the event of the withdrawal of said bid within the period specified, or the failure to enter into such contract and give such bonds within the time specified, if the Principal shall pay the Authority the difference between the amount specified in said bid and the amount for which the Authority may procure the required work or supplies or both, if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

| is | day of | | 20 | |
|-------------|------------------------------|-----------|-------------------------|--|
| | | | | |
| | | | | |
| F THE PRIN | NCIPAL IS AN INDIVIDUAL, SIG | N HERE | | |
| | | | | |
| (Prin | nted or Typed Name) | | (Printed or Typed Name) | |
| Witness | | Principal | (| |
| { | | | { | |
| | (Signature and Date) | | (Signature and Date) | |
| | | | | |
| SURETY SIG | GN HERE | | | |
| (SURET) | Y | | | |
| SEAL) | | | | |
| | | | | |
| | (Printed or Typed Name) | | (Printed or Typed Name) | |
| 1ttest { | | Surety*** | { | |
| | | | • | |
| | | | | |

| SIGNED, SEALED AND DELIVERED IN | ORIGINAL COUNTERPARTS |
|---------------------------------|-----------------------|
|---------------------------------|-----------------------|

this _____ day of _____ 20____.

IF THE PRINCIPAL IS A PARTNERSHIP, SIGN HERE

| | | (Printed or Typed Name) | - | (Printed or Typed Name) |
|------------|------------|--|---------------------------------|--|
| Witness | { | | Partner* | { |
| | C | (Signature and Date) | - | (Signature and Date) |
| | | (Printed or Typed Name) | - | (Printed or Typed Name) |
| Witness | { | | Partner* | { |
| | C | (Signature and Date) | - | (Signature and Date) |
| * SURET | add | ne Bidder is a partnership, the Bond must be signed resses must be listed on the certificate on page BF-3 IGN HERE | l in the name of -P of the Bid. | of the partnership by at least two general partners, whose names and |
| (SU SE | RET AL) | | | |
| | | (Printed or Typed Name) | - | (Printed or Typed Name) |
| Attest | { | | Surety*** | * |
| | | (Signature and Date) | - | (Signature and Date) |
| *** | Pov | ver of attorney must be attached to this Bid Bond. | | |

SHEET - BB-C-1

| SIGNED, SEALED AND DELIVERED IN | | | ORIGINAL COUNTERPARTS | | | |
|---------------------------------|----------------------------|--|------------------------------------|---|--|--|
| this | | day of | | 20 | | |
| (C | E PRINCI Orpora Eal) | PAL IS A CORPORATION, SIG | GN HERE | | | |
| | | | | (Corporate Name) | | |
| | (Priz | nted or Typed Name) | | (Printed or Typed Name) | | |
| Attest | { | | <i>President</i> <i>V.P.</i> ** | { | | |
| | (Sig | nature and Date) | | (Signature and Date) | | |
| | (Con | rporate Title) | | (Corporate Title) | | |
| ** | attested t | | or Treasurer or Assis | ion's correct corporate name by its President or Vice President and tant Treasurer, and the Certification of Corporate Principal below | | |
| | | | | PAL , certify that I am the poration named a Bidder herein; that | | |
| | | (check one) | - | | | |
| | | | | who signed this Bid on behalf of the | | |
| | | Corporation was then signature and his signature the in behalf of said Corporation b | reto is genuine; a | of said Corporation that I know his nd that said Bid was duly signed, sealed and attested governing body. | | |
| | | (CORPORATE SEAL) | | | | |
| | | (Sig | nature and Date) | | | |
| | | | | | | |
| | | | | | | |

SURETY SIGN HERE

(SURETY SEAL)

| | (Printed or | · Typed Name) | | (Pri | inted or Typed Name) |
|--------|------------------|------------------------------------|-----------|------|----------------------|
| Attest | | | Surety*** | | |
| | { | | | { | |
| | | | | | |
| | (Signature | and Date) | | | (Signature and Date) |
| *** | Power of attorne | ey must be attached to this Bid Bo | nd. | | |

Bid Bond 00410 - 5

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH

STATEMENT OF BIDDER'S QUALIFICATIONS

| | Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09 |
|---|--|
| (Bidder's Name) | (Project Name) |
| (Address) | |
| | (HACP Project No.) |
| Names of not more than two principals to contact: | |
| Name: | Name: |
| Title: | Title: |
| Telephone: | Telephone: |
| AUTHORIZATION: | |

Excerpt from HUD 7460.8-REV-1 AND 24 CFR 85.36(b)(8) & 24 CFR 905.160(a)(3):

"The evaluation of a contractor's ability to perform a contract is known as determining the contractor's responsibility. Has **shall** make awards only to **responsible** contractors possessing the ability to perform successfully under the terms and conditions of a proposed contract. Consideration **shall** be given to such matters as **contractor integrity, compliance with public policy, record of past performance, and financial and technical resources**.

"The award of a contract to an offeror **shall** not be made solely on the basis of the lowest evaluated price without considering the firm's ability to perform the required work. Some of the specific factors to consider include (1) whether the contractor performed satisfactorily on other HA Contracts, (2) is the contractor suspended or debarred from Federal Contracts, and (3) have other HAs has satisfactory performance from this contractor.

"A pre-award survey may entail an on-site inspection of the offeror's facilities, including a review of financial statements, record keeping, production capacity, or similar factors that impact on the ability to perform the contract.

"Recent unsatisfactory performance regarding either quality or timeliness of delivery is an example of a problem which the Contracting Officer **shall** consider and resolve as to its impact on the current procurement prior to making an affirmative determination of responsibility.

ORGANIZATION

THE BIDDER IS:

- [] An individual doing business in his/her own name
- [] An individual doing business under a fictitious or assumed name
- [] A General Partnership
 - [] Doing business under Partnership Name
 - [] Doing business under a fictitious or assumed name
- [] A Limited Partnership
 - [] Doing business under Partnership Name
 - [] Doing business under a fictitious or assumed name
- [] A corporation doing business in its own name
- [] A corporation doing business under a fictitious or assumed name

How many years has the bidder been in business as a Contractor?

How many years has the bidder been in business under its present business name?

Under what other or former names has the bidder operated?

PAST PERFORMANCE

CLAIMS AND SUITS. (If the answer to any of the questions below is yes, please attach explanation.)

- [] Yes [] No Has the Bidder ever failed to complete any work awarded to it?
- [] Yes [] No Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against the bidder or its officers?
- [] Yes [] No Has the bidder filed any law suits or requested arbitration with regard to construction contracts within the last five years?
- [] Yes [] No Within the last five years, has any officer or principal of the bidder ever been an officer or principal of another organization when it failed to complete a construction contract? (If answer is yes, please attach details.)

State average annual amount of construction work performed during the past five years: \$_____

State total worth of work in progress and under contract: \$_____

On a separate sheet, list major construction projects the bidder has in progress, giving the name of project, owner, architect, contract amount, percent complete and scheduled completion date.

On a separate sheet, list the major projects the bidder has completed in the past five years, giving the name of project, owner, architect, contract amount, date of completion and percentage of the cost of the work performed with your own forces.

FINANCIAL RESOURCES

Financial Statement.

Attach a financial statement (audited if available), including the bidder's latest balance sheet and income statement showing the following items:

Current Assets (e.g. cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses); Net Fixed Assets; Other Assets; Current Liabilities (e.g. accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes); Other Liabilities (e.g. capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

Name and address of firm preparing attached financial statement, and date thereof:

[] Yes [] No Is the attached financial statement for the identical organization named on page one?

If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

[] Yes [] No Will the organization whose financial statement is attached act as guarantor of the contract for construction?

TECHNICAL RESOURCES

Licensing:

List jurisdictions and trade categories in which the bidder is legally qualified to do business, and indicate registration or license numbers, if applicable.

Experiences: List the categories of work that the bidder normally performs with its own forces.

On a separate sheet, list the construction experience and present commitments of the key individuals of the bidder.

REFERENCES

List Trade References (use separate sheet if necessary):

List Bank References (use separate sheet if necessary):

List previous HUD/USDA-FmHA projects and Section 8 Contracts (formerly Schedule A on HUD-2530). Applicable to construction contracts exceeding \$50,000. List each principals name, previous project, principal's participation role and interest, and disclose defaults, mortgage relief, assignments and foreclosures. Note that having a Master Schedule on file with HUD will not meet this requirement.

Certifications: I (meaning the individual who signs as well as the corporations, partnerships or other parties listed above who certify) hereby apply to HUD or USDA-FmHA, as the case may be, for approval to participate as a principal in the role and project listed above based upon my following previous participation record of this Certification.

I certify that all the statements made by me are true, complete and correct to the best of my knowledge and belief and are made in good faith, including the data contained in Schedule A and Exhibits, signed by me and attached to this form.

Warning: HUD and/or the Authority will prosecute false claims and statements. Conviction may result in criminal and/or civil penalties. (18 U.S.C. 1001, 1012;31 U.S.C. 3729, 3802)

I further certify that:

- 1. The list of previous HUD/USDA-FmHA projects and Section 8 Contracts contains a listing of every assisted or insured project of HUD, which I have been or am now a principal.
- 2. For the period beginning 10 years prior to the date of this certification, and except as shown by me on the certification.
 - a. No mortgage on a project listed by me has ever been in default, assigned to the Government or foreclosed, nor has mortgage relief by the mortgagee been given;
 - b. I have not experienced default or noncompliance under any Conventional Contract or Turnkey Contract of Sale in connection with a public housing project;
 - c. To the best of my knowledge, there are no unresolved findings raised as a result of HUD audits, management reviews or other Governmental investigations concerning me or my projects;
 - d. There has not been a suspension or termination of payments under any HUD assistance contract in which I have had a legal or beneficial interest;
 - e. I have not been convicted of a felony and am not presently, to my knowledge, the subject of a complaint or indictment charging a felony. (A felony is defined as any offense punishable by imprisonment for a term exceeding one year, but does not include any offense classified as a misdemeanor under the laws of a State and punishable by imprisonment of two years or less);
 - f. I have not been suspended, debarred or otherwise restricted by any Department or Agency of the Federal Government or of a State Government from doing business with such Department or Agency.

- g. I have not defaulted on an obligation covered by a surety or performance bond and have not been the subject of a claim under an employee fidelity bond.
- 3. All the names of the parties, known to me to be principals in this project(s) in which I propose to participate, are listed above.
- 4. I am not a HUD/FmHA employee or a member of a HUD/FmHA employee's immediate household as defined in Standards of Ethical Conduct for Employees of the Executive Branch in 5 C.F.R. Part 2635 (57 FR 35006) and HUD's Standard of Conduct in 24 C.F.r. Part O and USDA's Standard of Conduct in 7 C.F.R. Part 9 Subpart B.
- 5. I am not a Housing Authority of the City of Pittsburgh employee or a member of an Authority employee's immediate family.
- 6. I am not a principal participant in an assisted or insured project as of this date on which construction has stopped for a period in excess of 20 days or which has been substantially completed for more than 90 days and documents for closing, including final cost certification have not been filed with HUD or FmHA.
- 7. To my knowledge I have not been found by HUD or FmHA to be in noncompliance with any applicable civil rights law.
- 8. I am not a Member of Congress or a Resident Commissioner nor otherwise prohibited or limited by law from contracting with the Government of the United States of America.
- 9. Statements above (if any) to which I cannot certify have been deleted by striking through the words with a pen. I have initialed each deletion (if any) and have attached a true and accurate signed statement (if applicable) to explain the facts and circumstances which I think helps to qualify me as a responsible principal for participation in this project.

(Signature and Date) (Typed or Printed Name) (Title) (Company Name) Subscribed and sworn to before me this_____ day of _____, 20 ______My Commission expires _____, 20 All section 3 covered contracts shall include the following clause (referred to as the section 3 clause):

- A. The work to be performed under this contract is subject to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing.
- B. The parties to this contract agree to comply with HUD's regulations in 24 CFR part 135, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 135 regulations.
- C. The contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin.
- D. The contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR part 135. The contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR part 135.
- E. The contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 135 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR part 135.
- F. Noncompliance with HUD's regulations in 24 CFR part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.
- G. With respect to work performed in connection with section 3 covered Indian housing assistance, section 7(b) of the Indian Self- Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of section 3 and section 7(b) agree to comply with section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).

Housing Authority City of Pittsburgh Development and Modernization Department Bidder's Section 3 Participation Form

A. Bidder's Section 3 Hiring Plan

| Job Category | Total Estimated Positions Needed for Project | No. Positions Occupied by Permanent Employees* | Number of Positions Not Occupied | Number of Positions Available for Section 3 Residents |
|--------------|--|---|--|--|
| Trade: | | | | |
| Journeyman | | | | |
| Helper | | | | |
| Apprentices | | | | |
| Trainees | | | | |
| Laborer | | | | |
| Others | | | | |

* Please submit a list of current employees to be assigned to this project including Dates of Hire

B. Bidder's Section 3 Subcontracting Plan

| SUB - CONTRACTOR'S NAME** | SUB - CONTRACTORS ADDRESS | PHONE NUMBER | FEDERAL TAX ID NO./ SS# | DESCRIPTION OF WORK | Sub - Contract Amount |
|------------------------------|---------------------------------|--------------|----------------------------|------------------------|-----------------------------|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

** If the Bidder has not identified a Section 3 subcontractor, please indicate if there will be any Section 3 subcontracting opportunity and describe scope of work_____

Company Name

Project Name

Project Number

Name and Title of Person Completing this Form

Signature and Date

PLACE HOLDER FOR

ROSTER OF CURRENT EMPLOYEES

Pursuant to Housing Authority of the City of Pittsburgh Section 3 Program Manual, Part I, Section A - Section 3 Policy Statement (in part):

"HACP shall examine and consider a contractor's potential for success in providing employment and business opportunities to those covered under Section 3 prior to acting on any proposed contract award. In response to any RFP, RFQ or IFB HACP will require submission of the Section 3 Opportunities Plan and roster of current employees, and certification that the bidder will comply with the requirements of Section 3."

Section 3 Participation

With respect to work performed in connection with Section 3 covered Indian housing assistance, Section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of Section 3 and Section 7(b) agree to comply with Section 3 to the maximum extent feasible, but not in derogation of compliance with Section 7(b).

| TOTAL LABOR DOLLARS USE TOTAL CONTRACT AMOUNT FOR SERVICE CONTRACTS | RESIDENT LABOR AS A % OF TOTAL LABOR DOLLARS |
|--|--|
| Labor dollars \$25,000 but less than \$100,000 | 10% of the labor dollars |
| \$100,000, but less than \$200,000 | 9% of the labor dollars |
| At least \$200,000, but less than \$300,000 | 8% of the labor dollars |
| At least \$300,000, but less than \$400,000 | 7% of the labor dollars |
| At least \$400,000, but less than \$500,000 | 6% of the labor dollars |
| At least \$500,000, but less than \$1 million | 5% of the labor dollars |
| At least \$1 million, but less than \$2 million | 4% of the labor dollars |
| At least \$2 million, but less than \$4 million | 3% of the labor dollars |
| At least \$4 million, but less than \$7 million | 2% of the labor dollars |
| \$7 million or more | $\frac{1}{2}$ to 1 % of the labor dollars |

RESIDENT HIRING REQUIREMENTS / RESIDENT HIRING SCALE

A copy of HACP's Section 3 Program Manual is available for download at <u>www.HACP.org</u>.



Business Opportunities and Employment Training for Housing Authority of the City of Pittsburgh Low Income Public Housing Residents (LIPH) and Area Residents of Low and Very Low Income Status (ARLIS)

| PRIME CONTRACTOR'S NAME: | |
|--------------------------------------|--|
| SPECIFICATION OR RFP/IFB/RFQ NUMBER: | |
| SPECIFICATION OR RFP/IFB/RFQ TITLE: | |

The Contractor hereby agrees to comply with all the provisions of Section 3 as set forth in 24 CFR 135.1 et seq. and the HACP Section 3 Policy and Program requirements. The Contractor hereby submits this document to identify employment opportunities for HACP residents (LIPH) and **Area Residents of Low and Very Low Income Status (ARLIS)** during the term of the contract between the Contractor and the HACP.

The preference of HACP is to ensure that as many HACP residents as possible are employed. In an effort to further that requirement, HACP has created a preference tier structure as outlined in the HACP Section 3 Policy and Program Manual which can be reviewed by visiting the "Vendor Services" section of www.hacp.org. Contractors are required to comply with Section 3 by first considering Tier I – Hiring. If the Contractor cannot meet its Section 3 requirement in Tier I and needs to move to Tier II or Tier III, that Contractor must document this inability to comply with the preference and the need to move to a lower tier. (Such inability <u>must</u> be documented for moves within tiers). The Contractor agrees to meet its Section 3 requirement following the Preferential Tier Structure as indicated by the selection below (check one or more tiers below):

[] Tier I – <u>HIRING</u>

The Contractor affirms that the jobs identified shall be for meaningful employment that may or may not be related to the scope of services covered under Contract/Purchase Order #______. The Contractor has committed to employ ______ resident(s) in order to comply with its Section 3 requirements. A prime contractor may satisfy the HACP Resident Hiring Requirements through his/her subcontractors. **Contact the HACP Resident Employment Program for resident referrals at 412-395-3950, Ext 1048.**

When Tier I is selected, the Contractor shall complete the following table as instructed below:

- (1) Indicate each job title for all phases of this contract
- (2) The number of positions that will be needed in each category
- (3) How many of those positions are currently filled
- (4) The number currently filled by low and very low-income HACP residents
- (5) The number currently filled by City of Pittsburgh neighborhood area residents
- (6) How many positions need to be filled

Indicate your requirement for the number of positions you intend to fill with:

- (7) Low income HACP Residents (LIPH) and/or
- (8) Low and very low income City of Pittsburgh Neighborhood Area Residents (ARLIS)



| Section 3 Labor Uti | ilization Ass | essment an | d Plan | | | | |
|---------------------|---------------------|---------------------|--------------------------|-----------------------|------------------------|-------------|---------------|
| SPEC or RFP TITLE | 2: | | | SPEC o | r RFP NUMI | BER: | |
| JOB TITLE | NUMBER OF POSITIONS | | | | | | ING REMENT |
| (1) | # NEEDED (2) | CUR TOTAL (3) | RENTLY FI LIPH (4) | ILLED ARLIS (5) | TO BE FILLED (6) | LIPH (7) | ARLIS (8) |
| | (4) | (3) | (4) | | | | |
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LIPH – HACP low income public housing resident ARLIS - Area Residents of Low/Very Low Income Status – (Area is the Pittsburgh metropolitan area)

In the event the value of Section 3 resident hiring is less than the amount identified in the Resident Hiring Scale, vendors must contribute to the HACP Education Fund an amount not less than the difference between the value of Section 3 hiring and the amount identified in the Resident Hiring Scale, which funds shall be used to provide other economic opportunities.

Therefore, if it is anticipated that any position listed above shall be for less than the full term of the contract period, you must indicate on the lines below, the anticipated term for each position:



[] Tier II – <u>CONTRACTING</u>

The contractor has identified ______ HACP resident-owned business(es) or ______ Section 3 business(es) which is/are 51 percent or more owned by Section 3 residents or 30 percent or more of their permanent full-time workforce are Section 3 residents. This will satisfy the contractor's Section 3 requirement covered under Contract/Purchase Order # ______.

In a one (1) page letter on your firm's letterhead:

1) Indicate the requirements, expressed in terms of percentage, of planned contracting dollars for the use of Section 3 business concerns as subcontractors.

2) A statement of the total dollar amount to be contracted, total dollar amount to be contracted to Section 3 business concerns for building trades, and total dollar amount to be contracted to Section 3 business concerns for other than building trades work (maintenance, repair, modernization, and development).

3) A description of the method used to develop the requirements above and the efforts to be undertaken by the contractor to meet those requirements.

[] Tier III - OTHER ECONOMIC OPPORTUNITIES

Firms may provide other economic opportunities to train and employ Section 3 residents or make a direct cash contribution to the HACP Education Fund. HACP has established the following minimum threshold requirements for provision of training or contribution to the HACP fund that provides other economic opportunities:

a) Contractor incurs the cost of providing skilled training for residents in an amount commensurate with the sliding scale set forth in the Resident Hiring Scale; or,

b) Contractor makes a contribution to the HACP Education Fund at Clean Slate E3 to provide assistance to residents to obtain training. The level of contribution would be commensurate with the sliding scale set forth in the Resident Hiring Scale.

Contractor shall provide, in a letter on firm letterhead:

- 1) Indication of the skilled training to be provided, the number of persons to be trained, the training provider, the cost of training, and the trainee recruitment plan; or,
- 2) Provide the amount of planned contribution to be made in relation to percentage of the contract labor hours costs. (Contribution checks should be made payable to: Clean Slate E3 Education Fund and mailed to Clean Slate E3, C/O Housing Authority of the City of Pittsburgh, Finance Department, 200 Ross Street, 9th Floor, Pittsburgh, PA 15219.

[] Tier IV – <u>No New Hire Opportunity</u>

If awarded this contract, the contractor will be able to fulfill the requirements of the IFB/RFP/RFQ with the existing work force. No new hires will be employed as a result of this award. If this position changes and hiring opportunities become necessary, the HACP Resident Employment Program will be notified.



By signing below, the Contractor hereby agrees to comply with the selected Section 3 requirements indicated above. To the extent that the completion of this form is contingent upon future information, for example price negotiations, request for specific services, etc., the undersigned hereby affirms and agrees to fully adhere to the spirit and intent of the HACP Section 3 Policy.

Furthermore, the undersigned acknowledges and affirms responsibility for completion and submission of this form as part of the response documentation for this Invitation for Bid or Request for Proposal. Failure to submit this form may jeopardize the responsiveness of your submission.

| Company Name: | |
|--------------------|-------|
| Name: | |
| Title: | |
| Signature: | Date: |
| Witness Name: | |
| Witness Signature: | Date: |

| | SOLICITAT MINORITY (MBE) AN | ITATION AND COMMITMENT STATEMENT E) AND FEMALE (WBE) OWNED BUSINESS ENTER | AITMENT | SOLICITATION AND COMMITMENT STATEMENT MINORITY (MBE) AND FEMALE (WBE) OWNED BUSINESS ENTERPRISES | |
|----------------------|---|--|----------------|---|---|
| BID NUMBER | NAME OF BIDDER | ADD | ADDRESS | | PHONE |
| List belo | List below All MBE/WBE's that were solicited - whether or not a commitment was obtained Copy this form as necessary | ited - whether or not | a commitme | nt was obtained Copy this form | as necessary |
| MBEWBE | TYPE OF SUBCONTRACT WORK OR MATERIALS | DATE SOLICITED BY PHONE BY MAIL | ΛE (E A | COMMITMENT MADE YES NO PATE) (IF YES, GIVE DATE) | GIVE REASON(S) IF NO COMMITMENT MADE |
| COMPANY NAME | | | | | |
| ADDRESS | | QUOTE RECEIVED | ED | AMOUNT COMMITTED | |
| CONTACT PERSON PHONE | | YES NO | PER | DOLLAR AMOUNT \$ PERCENT OF TOTAL BID % | |
| WBEWBE | TYPE OF SUBCONTRACT WORK OR MATERIALS | DATE SOLICITED BY PHONE BY MAIL | ΥE (ΕΛ | COMMITMENT MADE YES NO DATE) (IF YES, GIVE DATE) | GIVE REASON(S) IF NO COMMITMENT MADE |
| COMPANY NAME | | | | | |
| ADDRESS | | QUOTE RECEIVED | ED | AMOUNT COMMITTED | |
| CONTACT PERSON PHONE | | YES NO | DO | DOLLAR AMOUNT \$ | |
| | | | PER | PERCENT OF TOTAL BID % | |
| WBEWBE | TYPE OF SUBCONTRACT WORK OR MATERIALS | DATE SOLICITED BY PHONE BY MAIL | VE | COMMITMENT MADE YES NO NO NO | GIVE REASON(S) IF NO COMMITMENT MADE |
| COMPANY NAME | | | | | |
| ADDRESS | | QUOTE RECEIVED | ED | AMOUNT COMMITTED | |
| CONTACT PERSON PHONE | | YES NO | DO | DOLLAR AMOUNT \$ | |
| | | | PER | PERCENT OF TOTAL BID % | |

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH MBE/WBE SOLICITATION AND COMMITMENT RECORD

NOTE: Certification and letters of intent for each MBE/WBE commitment must accompany this document.

Title:

Prepared by:

Phone:

MBE/WBE Participation Plan

| Yes No II. MNORITY BUSINESS PARTICIPATION Yes No Is the Bidder classified as a Minority Business Yes No Enterprise? Yes No Yes No No Minority Business enterprises? Salue Contract Yes No No Minority Business enterprises? Salue Contract | I. SMALL BUSINESS PARTICIPATION Is the Bidder a Small Business as defined by the size and standards in 13 CFR 121? | CIPATION as defined by R 121? | | III. WOMEN-OWNED BUSINESS PARTICIPATION Is the Bidder classified as a Woman-Owned | SS an-Owned | |
|---|--|-------------------------------------|----------|---|--------------------------|----------|
| If "No", area any Subcontractors classified as Women-Owned Business Enterprises? Women-Owned Business Enterprises? Yes No If "Yes", please fill in the following chart: If "WeB" S Value Contract Iract % of Fee | Yes | No | | | 0 | |
| as If "Yes", please fill in the following chart: If "Yes", please fill in the following chart: Consulting Firm(s) S Value Contract (WBE) Contract % of Fee | II. MINORITY BUSINESS PA Is the Bidder classified as a Min Enterprise? | ARTICIPATION nority Business | | If "No", area any Subcontractors o Women-Owned Business Enterpri Ves | lassified as ises? | |
| as If "Yes", please fill in the following chart: | Yes | No | | | | |
| Consulting Firm(s) & Value Contract (WBE) | If "No", are any Subcontractors Minority Business enterprises? | s classified as | | If "Yes", please fill in the followin | ıg chart: | |
| : Contract % of Fee | Yes | No | | Consulting Firm(s) (WRE) | \$ Value Contract | % of Fee |
| \$ Value Contract | If "Yes", please fill in the follov | wing chart: | | | | |
| | Consulting Firm(s) (MBE) | \$ Value Contract | % of Fee | | | |
| | | | | | | |
| | | | | | | |

**All MBE/WBE firms must be certified. In order for the MBE/WBE participation plan to be complete, copies of MBE/WBE certification must be included for all firms listed.

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH MBE/WBE RECORD MBE/WBE SOLICITATION AND COMMITMENT STATEMENT **MBE/WBE 3-YEAR RECORD**

| BIDDERS NAME: | |
|-----------------------|--|
| ADDRESS: | |
| TELEPHONE: | |
| CONTACT PERSON: | |
| PROPOSAL AND BID FOR: | |

| List below all | List below all contracts with the Housing Authority of the City of Pittsburgh during the past three years and the MBE and WBE participation obtained. | | | | | | |
|----------------|--|----------|-----|-----|----------|--|--|
| CONTRACT TITLE | CONTRACT | | | | | | |
| | DATE | AMOUNT | MBE | WBE | COMMENTS | | |
| | DITL | 71000111 | MDL | | COMMENTS | | |
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Prepared by:

Title:

Phone:

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH MBE/WBE SOLICITATION AND COMMITMENT STATEMENT ADDITIONAL INFORMATION SHEET

The bidder presents the following as additional and supplemental information to its MBE/WBE Solicitation and Commitment Statement.

Prepared by:

Title:

Phone:

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH MBE/WBE EXHIBIT

MBE/WBE COMMITMENT WAIVER REQUEST FORM

| DDER'S FIRM: | |
|----------------------|--|
| DDRESS: | |
| ELEPHONE: | |
| ONTACT PERSON: | |
| ROPOSAL AND BID FOR: | |
| | |

Waiver of the MBE/WBE participation requirement is requested for the following reasons:

Prepared by:

Title: Phone:

NOTE: The fully completed MBE/WBE Solicitation and Commitment Statement must accompany this waiver request.

Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11625)

- 1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.
- 2. The goals for minority and female participation at the Housing Authority of the City of Pittsburgh are pursuant to the Mayor's promulgated Executive Order, and the action of the Housing Authority Board. Expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, these goals are seventeen percent (18%) of the total cost of the contract to be expended for minority participation and six percent (7%) for women participation. These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with the Executive Order and the regulations in Section 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in Section 41 CFR Part 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in Section 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification, within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation, to:

LaVaris Ross, Labor Relations Specialist U.S. Department of Housing and Urban Development Office of Labor Relations City Crescent Building 10 S. Howard Street, 5th Floor Baltimore, MD 21201

The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is within the Commonwealth of Pennsylvania, County of Allegheny, City of Pittsburgh.



NOTICE TO ALL PROSPECTIVE BIDDERS

REQUEST FOR MANPOWER PLAN Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP CONTRACT NO. <u>600-19-21</u>

Each bid must include a separate <u>Manpower Plan and Major Equipment List</u> for this Invitation for Bids. The Manpower Plan must include (1) the names of the bidder's personnel to be assigned to the Project, (2) trade/position, (3) Social Security Number or Driver's License Number and (4) Employee Date of Hire.

In the event you are bidding on multiple HACP construction work, each bid must include a separate Manpower Plan and Major Equipment List that clearly demonstrates that the bidder has the capacity and will not use the same personnel and equipment on more than one HACP construction work that are being executed simultaneously within the next 180 days.

HACP will use this information to determine whether the bidder has the capacity to perform the work.

Please acknowledge receipt of this Notice by completing the information below and the attached and including copies in your bid.

Bidder's Name: _____

Name of the Person Signing the Bid: _____

Signature of the Person Signing the Bid: _____

Bid Due Date: _____



Bidder's Planned Manpower

Provide Employee Name, Trade/Position, Social Security Number or Driver's License Number and Date of Hire for each employee:

(use additional sheets if necessary).

| Name | Position | Social Security No. or | r Driver's License No. | Date of Hire |
|------|----------|------------------------|------------------------|--------------|
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SPECIAL PROVISIONS FOR INVITATION FOR BIDS (IFB)

REQUEST FOR INFORMATION

Each bidder must submit the following information to assist the Owner to determine if the Bidder has the capacity to perform the required work under this **Project Name:_____ IFB No._____**.

Bidder's Capacity

Provide information demonstrating the Bidder's ability to provide the resources necessary for the timely and efficient implementation of the construction work. Due to the nature of this procurement, capacity will also be evaluated based on the Bidder's ability to complete the work on time and within budget, therefore, please describe the Bidder's Capacity as follows:

- 1. Manpower Plan and Major Equipment List (Please complete Form 00435-1 & 2).
- 2. List a maximum of three-(3) current or completed *Housing Authority of the City of Pittsburgh* related projects, the **Initial Contract Value**, **Change Orders**, **if any**, **and Final Contract Value**. If the project was not completed within budget and on time, please explain the circumstances and/or justification for the change order(s): Please attach a separate sheet if you do not have sufficient space.

| | Project # | Initial | Contract Value | Change Order(s) | Final Contract Value |
|-----------|----------------------------------|------------|---|---------------------------|------------------------------|
| a. | | | | | |
| b. | | | | | |
| c. Jus | stification for Chan | ige Orders | s/Schedule: | | |
| 3. | List at least three information: | e-(3) othe | er Owners including on | e current or completed | l project plus the following |
| Ve | ndor's Name & C | Contact # | Initial Contract Valu | e Change Order(s) | Final Contract Value |
| a. | | | | | |
| b. | | | | | |
| c. Jus | stification for Chan | ige Orders | s/Schedule: | | |
| | • | 0 | he information provided a e rejection of this bid: | above is accurate/correct | and provision of false |

| Bidder's Name: | Bidder's Signature: | |
|----------------|---------------------|--|
| Date: | - | |



NOTICE TO ALL PROSPECTIVE BIDDERS

Previous Related Experience

for

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP CONTRACT NO. 600-19-21

The bidder shall list three (3) firms, governmental units, or persons for whom the bidder has previously performed work of the nature requested under this IFB. Bidder shall list as references all housing authorities, including HACP, for whom the bidder has previously performed work of the nature requested under this IFB. HACP reserves the right to contact such persons at anytime prior to award and the bidder agrees that HACP may rely on information provided by such persons to determine the bidder's responsibility.

In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

| | Reference 1 | | | | |
|-----------------|----------------------------------|------------------------------|-------------------|--|--|
| Project: | Project: | | | | |
| Contact: | | | | | |
| Contact | Telephone Number: | | | | |
| Contract | Amount: | | | | |
| | | Change Orders | | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | | |
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HACP CONTRACT NO. 600-19-21

The bidder shall list three (3) firms, governmental units, or persons for whom the bidder has previously performed work of the nature requested under this IFB. Bidder shall list as references all housing authorities, including HACP, for whom the bidder has previously performed work of the nature requested under this IFB. HACP reserves the right to contact such persons at anytime prior to award and the bidder agrees that HACP may rely on information provided by such persons to determine the bidder's responsibility.

In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

| | Reference 2 | | | | |
|-----------------|----------------------------------|-----------------------|-------------------|--|--|
| Project: | | | | | |
| Contact: | | | | | |
| Contact | Telephone Number: | | | | |
| Contract | t Amount: | | | | |
| | | Change Orders | | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | | |
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Previous Related Experience for

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP CONTRACT NO. 600-19-21

The bidder shall list three (3) firms, governmental units, or persons for whom the bidder has previously performed work of the nature requested under this IFB. Bidder shall list as references all housing authorities, including HACP, for whom the bidder has previously performed work of the nature requested under this IFB. HACP reserves the right to contact such persons at anytime prior to award and the bidder agrees that HACP may rely on information provided by such persons to determine the bidder's responsibility.

In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

| | Reference 3 | | | | |
|-----------------|----------------------------------|-----------------------|--------------------------|--|--|
| Project: | | | | | |
| Contact: | | | | | |
| | Telephone Number: | | | | |
| Contract | Amount: | | | | |
| | | Change Orders | | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | | |
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HACP CONTRACT NO. 600-19-21

The bidder shall list three (3) firms, governmental units, or persons for whom the bidder has previously performed work of the nature requested under this IFB. Bidder shall list as references all housing authorities, including HACP, for whom the bidder has previously performed work of the nature requested under this IFB. HACP reserves the right to contact such persons at anytime prior to award and the bidder agrees that HACP may rely on information provided by such persons to determine the bidder's responsibility.

In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

| | Reference 4 | | | | |
|-----------------|----------------------------------|------------------------------|-------------------|--|--|
| Project: | Project: | | | | |
| Contact: | | | | | |
| | Telephone Number: | | | | |
| Contract | Amount: | | | | |
| | | Change Orders | | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | | |
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HACP CONTRACT NO. 600-19-21

The bidder shall list three (3) firms, governmental units, or persons for whom the bidder has previously performed work of the nature requested under this IFB. Bidder shall list as references all housing authorities, including HACP, for whom the bidder has previously performed work of the nature requested under this IFB. HACP reserves the right to contact such persons at anytime prior to award and the bidder agrees that HACP may rely on information provided by such persons to determine the bidder's responsibility.

In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

| | Reference 5 | | | | |
|-----------------|----------------------------------|------------------------------|-------------------|--|--|
| Project: | Project: | | | | |
| Contact: | | | | | |
| | Telephone Number: | | | | |
| Contract | Amount: | | | | |
| | | Change Orders | | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | | |
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HACP CONTRACT NO. 600-19-21

The bidder shall list three (3) firms, governmental units, or persons for whom the bidder has previously performed work of the nature requested under this IFB. Bidder shall list as references all housing authorities, including HACP, for whom the bidder has previously performed work of the nature requested under this IFB. HACP reserves the right to contact such persons at anytime prior to award and the bidder agrees that HACP may rely on information provided by such persons to determine the bidder's responsibility.

In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

| | Reference 6 | | | |
|-----------------|----------------------------------|------------------------------|-------------------|--|
| Project: | | | | |
| Contact: | | | | |
| Contact | Telephone Number: | | | |
| Contract | t Amount: | | | |
| | | Change Orders | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | |
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HACP CONTRACT NO. 600-19-21

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In addition to the references, all bidders will provide the last three jobs they performed, contact information from the job and all change orders related to the job and the reason for each.

All bidders will provide information on the most recet HACP job to include all change order information and the reason for each. The most recent HACP job can be one of the 3 last jobs performed if that is the case.

| | Reference 7 | | | | |
|-----------------|----------------------------------|------------------------------|--------------------------|--|--|
| Project: | | | | | |
| Contact: | | | | | |
| Contact | Telephone Number: | | | | |
| Contract | Amount: | | | | |
| | | Change Orders | | | |
| Number | Total \$ Value per Change | Description of Change | Reason for Change | | |
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*All contractors <u>MUST</u> submit 3 references and most recent HACP Job if applicable.

U.S. Department of Housing and Urban Development

Office of Public and Indian Housing

Representations, Certifications, and Other Statements of Bidders Public and Indian Housing Programs

Representations, Certifications, and Other Statements of Bidders

Public and Indian Housing Programs

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1. Certificate of Independent Price Determination

(a) The bidder certifies that--

(1) The prices in this bid have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other bidder or competitor relating to (i) those prices, (ii) the intention to submit a bid, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this bid have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to any other bidder or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a competitive proposal solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the bidder to induce any other concern to submit or not to submit a bid for the purpose of restricting competition.

(b) Each signature on the bid is considered to be a certification by the signatory that the signatory--

(1) Is the person in the bidder's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(l) through (a)(3) above; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(I) through (a)(3) above.

[insert full name of person(s) in the bidder's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the bidder's organization];

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above.

(c) If the bidder deletes or modifies subparagraph (a)2 above, the bidder must furnish with its bid a signed statement setting forth in detail the circumstances of the disclosure.

Contracting Officer check if following paragraph is applicable]
 Non-collusive affidavit. (applicable to contracts for construction and equipment exceeding \$50,000)

(1) Each bidder shall execute, in the form provided by the PHA/ IHA, an affidavit to the effect that he/she has not colluded with any other person, firm or corporation in regard to any bid submitted in response to this solicitation. If the successful bidder did not submit the affidavit with his/her bid, he/she must submit it within three (3) working days of bid opening. Failure to submit the affidavit by that date may render the bid nonresponsive. No contract award will be made without a properly executed affidavit.

(2) A fully executed "Non-collusive Affidavit" $\circle{1}$ is, $\circle{1}$ is not included with the bid.

2. Contingent Fee Representation and Agreement

(a) Definitions. As used in this provision:

"Bona fide employee" means a person, employed by a bidder and subject to the bidder's supervision and control as to time, place, and manner of performance, who neither exerts, nor proposes to exert improper influence to solicit or obtain contracts nor holds out as being able to obtain any contract(s) through improper influence.

"Improper influence" means any influence that induces or tends to induce a PHA/IHA employee or officer to give consideration or to act regarding a PHA/IHA contract on any basis other than the merits of the matter.

(b) The bidder represents and certifies as part of its bid that, except for full-time bona fide employees working solely for the bidder, the bidder:

(1) [] has, [] has not employed or retained any person or company to solicit or obtain this contract; and

(2) [] has, [] has not paid or agreed to pay to any person or company employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

(c) If the answer to either (a)(1) or (a)(2) above is affirmative, the bidder shall make an immediate and full written disclosure to the PHA/IHA Contracting Officer.

(d) Any misrepresentation by the bidder shall give the PHA/IHA the right to (1) terminate the contract; (2) at its discretion, deduct from contract payments the amount of any commission, percentage, brokerage, or other contingent fee; or (3) take other remedy pursuant to the contract.

3. Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions (applicable to contracts exceeding \$100,000)

(a) The definitions and prohibitions contained in Section 1352 of title 31, United States Code, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The bidder, by signing its bid, hereby certifies to the best of his or her knowledge and belief as of December 23, 1989 that:

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of a contract resulting from this solicitation;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the bidder shall complete and submit, with its bid, OMB standard form LLL, "Disclosure of Lobbying Activities;" and

(3) He or she will include the language of this certification in all subcontracts at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(d) Indian tribes (except those chartered by States) and Indian organizations as defined in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) are exempt from the requirements of this provision.

4. Organizational Conflicts of Interest Certification

The bidder certifies that to the best of its knowledge and belief and except as otherwise disclosed, he or she does not have any organizational conflict of interest which is defined as a situation in which the nature of work to be performed under this proposed contract and the bidder's organizational, financial, contractual, or other interests may, without some restriction on future activities:

(a) Result in an unfair competitive advantage to the bidder; or,

(b) Impair the bidder's objectivity in performing the contract work.

[] In the absence of any actual or apparent conflict, I hereby certify that to the best of my knowledge and belief, no actual or apparent conflict of interest exists with regard to my possible performance of this procurement.

5. Bidder's Certification of Eligibility

(a) By the submission of this bid, the bidder certifies that to the best of its knowledge and belief, neither it, nor any person or firm which has an interest in the bidder's firm, nor any of the bidder's subcontractors, is ineligible to:

(1) Be awarded contracts by any agency of the United States Government, HUD, or the State in which this contract is to be performed; or,

(2) Participate in HUD programs pursuant to 24 CFR Part 24.

(b) The certification in paragraph (a) above is a material representation of fact upon which reliance was placed when making award. If it is later determined that the bidder knowingly rendered an erroneous certification, the contract may be terminated for default, and the bidder may be debarred or suspended from participation in HUD programs and other Federal contract programs.

6. Minimum Bid Acceptance Period

(a) "Acceptance period," as used in this provision, means the number of calendar days available to the PHA/IHA for awarding a contract from the date specified in this solicitation for receipt of bids.

(b) This provision supersedes any language pertaining to the acceptance period that may appear elsewhere in this solicitation.

(c) The PHA/IHA requires a minimum acceptance period of [Contracting Officer insert time period] calendar days.

(d) In the space provided immediately below, bidders may specify a longer acceptance period than the PHA's/IHA's minimum requirement. The bidder allows the following acceptance period: calendar days.

(e) A bid allowing less than the PHA's/IHA's minimum acceptance period will be rejected.

(f) The bidder agrees to execute all that it has undertaken to do, in compliance with its bid, if that bid is accepted in writing within (1) the acceptance period stated in paragraph (c) above or (2) any longer acceptance period stated in paragraph (d) above.

7. Small, Minority, Women-Owned Business Concern Representation

The bidder represents and certifies as part of its bid/ offer that it --

(a) [] is, [] is not a small business concern. "Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR 121.

(b) [] is, [] is not a women-owned business enterprise. "Womenowned business enterprise," as used in this provision, means a business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business.

(c) [] is, [] is not a minority business enterprise. "Minority business enterprise," as used in this provision, means a business which is at least 51 percent owned or controlled by one or more minority group members or, in the case of a publicly owned business, at least 51 percent of its voting stock is owned by one or more minority group members, and whose management and daily operations are controlled by one or more such individuals. For the purpose of this definition, minority group members are:

(Check the block applicable to you)

- [] Black Americans
- [] Hispanic Americans
- [] Asian Pacific Americans
- [] Asian Indian Americans
- [] Native Americans
- [] Hasidic Jewish Americans
- 8. Indian-Owned Economic Enterprise and Indian Organization Representation (applicable only if this solicitation is for a contract to be performed on a project for an Indian Housing Authority)

The bidder represents and certifies that it:

(a) [] is, [] is not an Indian-owned economic enterprise. "Economic enterprise," as used in this provision, means any commercial, industrial, or business activity established or organized for the purpose of profit, which is at least 51 percent Indian owned. "Indian," as used in this provision, means any person who is a member of any tribe, band, group, pueblo, or community which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs and any "Native" as defined in the Alaska Native Claims Settlement Act.

(b) [] is, [] is not an Indian organization. "Indian organization," as used in this provision, means the governing body of any Indian tribe or entity established or recognized by such governing body. Indian "tribe" means any Indian tribe, band, group, pueblo, or community including Native villages and Native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs.

9. Certification of Eligibility Under the Davis-Bacon Act (applicable to construction contracts exceeding \$2,000)

(a) By the submission of this bid, the bidder certifies that neither it nor any person or firm who has an interest in the bidder's firm is a person or firm ineligible to be awarded contracts by the United States Government by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of the contract resulting from this solicitation shall be subcontracted to any person or firm ineligible to be awarded contracts by the United States Government by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U. S. Criminal Code, 18 U.S.C. 1001.

10. Certification of Nonsegregated Facilities (applicable to contracts exceeding \$10,000)

(a) The bidder's attention is called to the clause entitled **Equal Employment Opportunity** of the General Conditions of the Contract for Construction.

(b) "Segregated facilities," as used in this provision, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise.

(c) By the submission of this bid, the bidder certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The bidder agrees that a breach of this certification is a violation of the Equal Employment Opportunity clause in the contract.

(d) The bidder further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) prior to entering into subcontracts which exceed \$10,000 and are not exempt from the requirements of the Equal Employment Opportunity clause, it will:

(1) Obtain identical certifications from the proposed subcontractors;

(2) Retain the certifications in its files; and

(3) Forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

Notice to Prospective Subcontractors of Requirement for Certifications of Nonsegregated Facilities

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Employment Opportunity clause of the prime contract. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

Note: The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

11. Clean Air and Water Certification (applicable to contracts exceeding \$100,000)

The bidder certifies that:

(a) Any facility to be used in the performance of this contract [] is, [] is not listed on the Environmental Protection Agency List of Violating Facilities:

(b) The bidder will immediately notify the PHA/IHA Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the Environmental Protection Agency, indicating that any facility that the bidder proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and,

(c) The bidder will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

12. Previous Participation Certificate (applicable to construction and equipment contracts exceeding \$50,000)

(a) The bidder shall complete and submit with his/her bid the Form HUD-2530, "Previous Participation Certificate." If the successful bidder does not submit the certificate with his/her bid, he/she must submit it within three (3) working days of bid opening. Failure to submit the certificate by that date may render the bid nonresponsive. No contract award will be made without a properly executed certificate.

(b) A fully executed "Previous Participation Certificate"

[] is, [] is not included with the bid.

13. Bidder's Signature

The bidder hereby certifies that the information contained in these certifications and representations is accurate, complete, and current.

(Signature and Date)

(Typed or Printed Name)

(Title)

(Company Name)

(Company Address)

US Department of Housing and Urban Development

Office of Housing/Federal Housing Commissioner

US Department of Agriculture Farmers Home Administration

| Part I to be completed by Controlling Participant(s) of Covered Projects | Participant(s) of Covered Projects | For HUD | For HUD HQ/FmHA use only | |
|---|--|-------------------|--|---|
| (See instructions) | | | | |
| 1. Agency name and City where the application is filed | lled | 2. Project Nar | 2. Project Name, Project Number, City and Zip Code | |
| | | | | |
| 3. Loan or Contract amount \$ | 4. Number of Units or Beds | 5. Section of Act | Act 6. Type of Project (check one) | ect (check one) |
| 7. List all proposed Controlling Participan | 7. List all proposed Controlling Participants and attach complete organization chart for all organizations showing ownership % | or all organ | izations showing ownership % | |
| Name and address (Last, First, Middle Initial) of controlling participant(s) proposing to participate | ontrolling participant(s) proposing to participate | | 8 Role of Each Principal in Project | 9. SSN or IRS Employer Number (TIN) |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Certifications: The controlling narticinants(s) listed ab | Certifications: The controlling marticinants(s) listed above hereby annly to HUD or USDA FmHA. as the case maybe. for annroval to narticinant as controlling marticinant(s) in the role(s) and moniect listed above. The | avhe. for annro | val to narticipate as controlling participant | s) in the role(s) and project listed above. The |

fraudulent statement, representation, or certification may result in criminal, civil, and/or administrative sanctions, including fines, penalties, and imprisonment. The controlling participants(s) further certify to the truth and controlling participant(s) certify that the information provided on this form and in any accompanying documentation is true and accurate. I/we acknowledge that making, presenting, or submitting a false, fictitious, or accuracy of the following:

1. Schedule A contains a listing, for the last ten years, of every project assisted or insured by HUD, USDA FmHA and/or State and local government housing finance agencies in which the controlling participant(s) have participated or are now participating.

2. For the period beginning 10 years prior to the date of this certification, and except as shown on the certification:

a. No mortgage on a project listed has ever been in default, assigned to the Government or foreclosed, nor has it received mortgage relief from the mortgagee;

b. The controlling participants have no defaults or noncompliance under any Conventional Contract or Turnkey Contract of Sale in connection with a public housing project;

c. There are no known unresolved findings as a result of HUD audits, management reviews or other Governmental investigations concerning the controlling participants or their projects;

d. There has not been a suspension or termination of payments under any HUD assistance contract due to the controlling participant's fault or negligence;

e. The controlling participants have not been convicted of a felony and are not presently the subject of a complaint or indictment charging a felony. (A felony is defined as any offense punishable by imprisonment for a term

f. The controlling participants have not been suspended, debarred or otherwise restricted by any Department or Agency of the Federal Government or of a State Government from doing business with such Department or exceeding one year, but does not include any offense classified as a misdemeanor under the laws of a State and punishable by imprisonment of two years or less); Agency;

g. The controlling participants have not defaulted on an obligation covered by a surety or performance bond and have not been the subject of a claim under an employee fidelity bond;

3. All the names of the controlling participants who propose to participate in this project are listed above.

4. None of the controlling participants is a HUD/FmHA employee or a member of a HUD/FmHA employee's immediate household as defined in Standards of Ethical Conduct for Employees of the Executive Branch in 5

5. None of the controlling participants is a participant in an assisted or insured project as of this date on which construction has stopped for a period in excess of 20 days or which has been substantially completed for more C.F.R. Part 2635 (57 FR 35006) and HUD's Standard of Conduct in 24 C.F.R. Part 0 and USDA's Standard of Conduct in 7 C.F.R. Part 0 Subpart B.

6.None of the controlling participants have been found by HUD or FmHA to be in noncompliance with any applicable fair housing and civil rights requirements in 24 CFR 5.105(a). (If any controlling participants have been than 90 days and documents for closing, including final cost certification, have not been filed with HUD or FmHA.

found to be in noncompliance with any requirements, attach a signed statement explaining the relevant facts, circumstances, and resolution, if any).

8. Statements above (if any) to which the controlling participant(s) cannot certify have been deleted by striking through the words with a pen, and the controlling participant(s) have initialed each deletion (if any) and have 7. None of the controlling participants is a Member of Congress or a Resident Commissioner nor otherwise prohibited or limited by law from contracting with the Government of the United States of America. attached a true and accurate signed statement (if applicable) to explain the facts and circumstances.

| Name of Controlling Participant | Signature of Controlling | Certification Date | Area Code and Tel. No. |
|------------------------------------|--------------------------|------------------------|------------------------|
| | Participant | (mm/dd/yyyy) | |
| | | 1 MILLION | |
| | | | |
| | | | |
| This form prepared by (print name) | Area Cod | Area Code and Tel. No. | |

Previous editions are obsolete

| Certification | TTO TAM OTTTO TO O |
|---------------|--------------------|
| nation | 10000 |
| 101 | |
| Part | - |
| Previous | |

Schedule A: List of Previous Projects and Section 8 Contracts. Below is a complete list of the controlling participants' previous participation projects and participation history in covered projects as per 24 CFR, part 200 §200.214 and multifamily Housing programs of FmHA, State and local Housing Finance Agencies, if applicable. Note: Read and follow the instruction sheet carefully. Make full disclosure. Add extra sheets if you need more space. Double check for accuracy. If no previous projects, write by your name, "No

| previous participation, First Experience" | | · | | 4 | |
|---|--|---|---|--|--|
| 1. Controlling Participants' Name (Last, First) | rst) 2. List of previous projects (Project name, project ID and, Govt. agency involved) | 3.List Participants' Role(s) (indicate dates participated, and if fee or identity of interest participant) | Status of loan (current, defaulted, assigned, foreclosed) | 5. Was the Project ever in default during your participation Yes No If yes, explain | 6. Last MOR rating and Physical Insp. Score and date |
| | | | | | |
| Part II- For HUD Internal Processing Only Received and checked by me for accuracy and completent | Part II- For HUD Internal Processing Only Received and checked by me for accuracy and completeness: recommend annoval or refer to Headouarters after checking annonriate box. | rters after checking annonriate box. | | | |
| Date (mm/dd/yyyy) | Tel No. and area code | A. No adverse information; form HUD-2530 approval | HUD-2530 approval | C. Disclosure or Certification problem | ication problem |
| Staff | Processing and Control | recommended. | | | |
| | | B. Name match in system | | D. Other (attach memorandum) | orandum) |

Previous editions are obsolete

Signature of authorized reviewer

Page 2 of 4

ref 24 CFR 200 Subpart H Form HUD-2530 (10/2016)

No No

Approved

Signature of authorized reviewer

Date (mm/dd/yyyy)

| Instructions for Completing the Previous Participation Certificate, form HUD-2530 |
|---|
| Carefully read these instructions and the applicable regulations. A copy of the regulations published at 24 C.F.R. part 200, subpart H, § 200.210-200.222 can be obtained on-line at <u>www.gpo.gov</u> and from the Account Executive at any HUD Office. Type or print neatly in ink when filling out this form. Incomplete form will be returned to the applicant. |
| Attach extra sheets as you need them. Be sure to indicate "Continued on Attachments" wherever appropriate. Sign each additional page that you attach if it refers to you or your record. Carefully read the certification before you sign it. Any questions regarding the form or how to complete it can be answered by your HUD Account Executive. |
| Purpose: This form provides HUD/USDA FmHA with a certified report of all previous participation in relevant HUD/USDA programs by those parties submitting the application. The information requested in this form is used by HUD/USDA to determine if you meet the standards established to ensure that all controlling participants in HUD/USDA projects will honor their legal, financial and contractual obligations and are of acceptable risks from the underwriting standpoint of an insurer, lender or governmental agency. HUD requires that you certify and submit your record of previous participation, in relevant projects, by completing and signing this form, before your participation can be approved. |
| HUD approval of your certification is a necessary precondition for your participation in the project and in the capacity that you propose. If you do not file this certification, do not furnish the information requested accurately, or do not meet established standards, HUD will not approve your certification. |
| Note that approval of your certification does not obligate HUD to approve your project application, and it does not satisfy all other HUD program requirements relative to your qualifications. |
| Who Must Sign and File Form HUD-2530: Form HUD-2530 must be completed and signed by all Controlling Participants of Covered Projects, as such terms are defined in 24 CFR part 200 §200.212, and as further clarified by the Processing Guide (HUD notice H 2016-15) referenced in 24 CFR §200.210(b) and available on the HUD website at: http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/mfh/prevparticipation . |
| Where and When Form HUD-2530 Must Be Filed: The original of this form must be submitted to the HUD Office where your project application will be processed at the same time you file your initial project application. This form must be filed with applications for projects listed in 24 CFR §200.214 and for the Triggering Events listed at 24 CFR §200.218. |

Review of Adverse Determination: If approval of your participation in a HUD project is denied, withheld, or conditionally granted on the basis of your record of previous participation, you will be notified by the HUD Office. You may request reconsideration in accordance with 24 CFR §200.222 and further clarified by the Processing Guide. Request must be made in writing within 30 days from your receipt of the notice of determination.

may not participate in a proposed or existing multifamily or healthcare project. HUD uses this information to evaluate whether or can become HUD-approved controlling participants. The information you provide will enable HUD to evaluate your record with The Department of Housing and Urban Development (HUD) is authorized to collect this information by law 42 U.S.C. 3535(d) and respect to established standards of performance, responsibility and eligibility. Without prior approval, a controlling participant by regulation at 24 CFR 200.210. This information is needed so that principals applying to participate in multifamily programs controlling participants and approve only individuals and organizations that will honor their legal, financial and contractual not controlling participants pose an unsatisfactory underwriting risk. The information is used to evaluate the potential obligations.

disclosed or released outside of HUD, except as required and permitted by law. You must provide all of the information requested Federally-insured or guaranteed loan to furnish his/her Social Security Number (SSN). HUD must have your SSN for identification and your previous records with other public agencies and private sector sources. HUD may disclose certain information to Federal, of your records. HUD may use your SSN for automated processing of your records and to make requests for information about you Privacy Act Statement: The Housing and Community Development Act of 1987, 42 U.S.C. 3543 requires persons applying for a State and local agencies when relevant to civil, criminal, or regulatory investigations and prosecutions. It will not be otherwise in this application, including your SSN.

reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. This agency may not collect this information, and you are not required to complete this form, unless Public reporting burden for this collection of information is estimated to average three hour per response, including the time for it displays a currently valid OMB control number.

A response is mandatory. Failure to provide any of the information will result in your disapproval of participation in this HUD program



SPECIAL PROVISIONS

NOTICE TO ALL PROSPECTIVE BIDDERS Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09 Documents Required for Payment HACP Contract No.: <u>600-19-21</u>

Pursuant to Sections 27, 38, 40 and 46 of the General Conditions for this Contract, each contractor must submit the following required documents with each Payment Estimate ("PE") in order for HACP to process a PE as follows:

- A. Periodic Estimate HUD 51001
- B. Schedule of Stored Materials HUD 51003 (if applicable)
- C. Summary of Stored Materials HUD 51004 (if applicable)
- **D. Schedule of Change Orders HUD 51002** (if applicable)
- **E. Progress Payment Certification**
- F. Current/Approved Certified Payrolls (submitted to HACP's Davis-Bacon Wage Clerk).
- G. MBE/WBE Utilization Report
- H. Section 3 Summary Report

Signature of Authorized Officer: _____ Date: _____

THIS DOCUMENT MUST BE SIGNED.

NON-COLLUSION AFFIDAVIT

(Project Name)

<u>600-19-21</u>; (HACP Contract No.)

and is the party making the foregoing Bid, and that such Bid is genuine and not collusive or sham; that said Bidder has not colluded, conspired, connived or agreed, directly or indirectly, with any Bidder or person, to put in a sham bid, or to refrain from bidding, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price of affiant or of any bidder, or to fix any overhead, profit or cost element of said bid price, or of that of any bidder, or to secure any advantage against the Housing Authority of the City of Pittsburgh or any person interested in the proposed contract; and that all statements in said Bid are true.

(Signature and Date)

Subscribed and sworn to before me

this_____ day of _____, 20___

My Commission expires _____, 20___

FORM OF AGREEMENT

| THIS AGREEMENT, made this | _ day of _ | in the year Two Thousand _ | (20 |) by and |
|---------------------------|------------|----------------------------|-----|----------|
| between: | | | | |

[] An individual doing business in his/her own name

[] An individual doing business under a fictitious or assumed name

[] A partnership

[] A Corporation

(Hereinafter called the Contractor)

AND

The Housing Authority of the City of Pittsburgh (hereinafter called the Authority) 200 Ross Street Pittsburgh, PA 15219

WITNESSETH: That the Contractor and the Authority, for the consideration stated herein, mutually agree as follows:

ARTICLE 1, STATEMENT OF WORK

The Contractor shall provide all labor, materials and equipment, and services necessary to perform and complete all work required in accordance with Architectural Innovations drawings for AMP-09

dated 09/28/2020 and Project Manual dated April 12, 2021 regarding:

CONTRACT NO. <u>600-19-21</u>

and addenda thereto numbered _____, all as prepared by _____, which said specifications, drawings, and addenda are incorporated herein by reference and are a part hereof.

The work shall begin at the time stipulated in the NOTICE TO PROCEED and in no event exceeding <u>120</u> consecutive calendar days from notice to proceed.

ARTICLE 2, THE CONTRACT PRICE

The Authority shall pay the contractor for the performance of the Contract in current fund, subject to additions and deductions as provided in the specifications.

_____ (\$_____)

ARTICLE 3, CONTRACT DOCUMENTS

The Contract shall consist of the following component parts:

- a. This Agreement
- b. Project Manual (including all component parts) dated April 12, 2021
- c. Project Drawings issued by Architectural Innovations dated 09/28/2020

This Agreement, together with the other documents enumerated in this Article 3 which said other documents are as fully a part of the Contract as if hereto attached or herein repeated, form the Contract. In the event that any provision in any component part of this Contract conflicts with any provision of any other component part, the provision of the component part first enumerated in this ARTICLE 3, shall govern, except as subsequent parts may establish more specific criteria or language in which case these criteria and language shall govern. The various provisions in Addenda shall be construed in the order of preference of the component part of the Contract which each modified.

| SIGNED, SEALED AND DELIVERED IN | ORIGINAL COUNTERPARTS |
|---------------------------------|-----------------------|
|---------------------------------|-----------------------|

this _____ day of _____ 20____.

IF THE PRINCIPAL IS AN INDIVIDUAL, SIGN HERE

By signing this Form of Agreement, if the Housing Authority accepts and signs Contract No. <u>600-19-21</u> this contract shall be binding on both parties.

(Printed or Typed Name)

(Printed or Typed Name)

Witness {

{

Principal

(Signature and Date)

(Signature and Date)

IF THE PRINCIPAL IS A PARTNERSHIP, SIGN HERE

By signing this Form of Agreement, if the Housing Authority accepts and signs Contract No. <u>600-19-21</u> this contract shall be binding on both parties.

| | | (Printed or Typed Name) | | (Printed or Typed Name) |
|---------|---|-------------------------|---------------|-------------------------|
| Witness | | | Partner* | |
| | { | | | { |
| | | (Signature and Date) | | (Signature and Date) |
| | | (Printed or Typed Name) | | (Printed or Typed Name) |
| Witness | { | | Partner* { | |
| | | (Signature and Date) | | (Signature and Date) |

* If the Bidder is a partnership, the Form of Agreement must be signed in the name of the partnership by at least two general partners, whose names and addresses must be listed on the certificate on page BF-3-P of the Bid.

IF THE PRINCIPAL IS A CORPORATION, SIGN HERE

By signing this Form of Agreement, if the Housing Authority accepts and signs Contract No. <u>600-19-21</u> this contract shall be binding on both parties.

(CORPORATE SEAL)

(Corporate Name)

(Printed or Typed Name)

(Signature and Date)

Witness

{

(Signature and Date)

ł

(Printed or Typed Name)

President V.P.**

(Corporate Title)

(Corporate Title)

** If the bidder is a corporation, the Form of Agreement must be executed in the Corporation's correct corporate name by its President or Vice President and attested to by its Secretary or Assistant Secretary or Treasurer or Assistant Treasurer, and the Certification of Corporate Principal (Doc. 00625) must be executed by the Secretary or Assistant Secretary.

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the Secretary/Assistant Secretary of the Corporation named a Bidder herein; that (Circle one)

_ who signed this Bid on behalf of the

Corporation was then ______ of said Corporation that I know his signature and his signature thereto is genuine; and that said Bid was duly signed, sealed and attested in behalf of said Corporation by authority of its governing body.

(CORPORATE SEAL)

(Signature and Date)

| | Secretary | | Kim Detrick, Chief Contracting Officer |
|--------|----------------------|------------------|--|
| Attest | { | Principal | { |
| | | | |
| | (Signature and Date) | | (Signature and Date) |
| | | | |
| | | Mon | ique L Pierre, Chief Development Officer |
| | | Approved as to | |
| | | Contents and Cos | ts { |
| | | | (Signature and Date) |
| | | | |
| | | | Assistant General Counsel |
| | | | Assistant General Counser |
| | | Approved as to | (|
| | | Form | { |
| | | | (Signature and Date) |

CONTRACTING OFFICER CERTIFICATION

I _______certify that I am the Recording Secretary of the Housing Authority of the City of Pittsburgh; that ______, who signed this Contract on behalf of the Housing Authority, was then Contracting Officer of said Authority; that the said Contract was duly signed for and on behalf of the Housing Authority of the City of Pittsburgh.

Secretary

____(SEAL)

PERFORMANCE BOND

THIS BOND IS ISSUED SIMULTANEOUSLY WITH PAYMENT BOND IN FAVOR OF THE AUTHORITY CONDITIONED ON THE FULL AND FAITHFUL PERFORMANCE OF THE CONTRACT.

KNOW ALL MEN BY THESE PRESENTS, that we,

| | , as Princi | pal, and |
|---|---------------------------------------|------------------|
| (Insert name and address of contractor exactly as it appears on Form of Agreement) | | |
| | | |
| | | |
| | , as Sureties, a | are |
| held and firmly bound unto the Housing Authority of the Ci (the Obligee, hereinafter called the "Authority") in the penal s | | sors, or assigns |
| | Dollars (\$ |) |
| lawful money of the United States, for the payment of which heirs, personal representatives, successors, and assigns, jointly | • | ourselves, our |
| WHEREAS, the Principal heretofore has submitted to th | e said Authority a certain bid, dated | |
| , 20 | (the "Bid"), for construction of | • |
| (Insert date of bid) | | |
| | | |
| | | |
| | | |
| (Insert name of project exactly as it appears on Form of Agreement) | | |

pursuant to specifications, drawings and other related documents constituting the Invitation for Bids (the "IFB"); and

WHEREAS, the said Authority is a "Contracting body" under provisions of Act No. 385 of the General Assembly of the Commonwealth of Pennsylvania, approved by the Governor on December 20, 1967, known and cited as the "Public Works Contractors' Bond Law of 1967" (8 P.S. 191-202) (the "Act"); and

WHEREAS, the Act, in Section 3 (a), requires that, before an award shall be made to the Principal shall furnish this Bond to the said Authority, with this Bond to become binding upon the award of a Contract to the Principal by the said Authority in accordance with the Bid; and

WHEREAS, it also is a condition of the IFB that this Bond shall be furnished by the Principal to the said Authority; and

WHEREAS, Under the Invitation for Bids, it is provided, inter alia, that if the Principal shall furnish this Bond to the said Authority, and if the said Authority shall make an award to the Principal in accordance with the Bid, then the Principal and the said Authority shall enter into a contract with respect to performance of such work (the "Contract"), the Form of Agreement for which is set forth in the IFB.

NOW, therefore, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the principal shall faithfully perform the Contract on his part as of the time and in the manner therein provided and satisfy all claims and demands incurred in or for the same, or growing out of the same, or for injury or damages to persons or property in the performance thereof, and shall fully indemnify and save harmless the said Authority from any and all cost and damage which the said Authority may suffer by reason of the principal's failure to do so, and shall fully reimburse and repay the said Authority any and all outlay and expense which it incurs by reason of any such default, then this obligation shall be null and void, otherwise it shall remain in full force and virtue.

It is further understood and agreed that the principal shall guarantee for a period of one (1) year from completion date of the contract against defects in workmanship or materials in accordance with the terms of the Contract.

The said surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications accompanying the same shall in any wise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the specifications.

| SIGNED, SI | EALED AND DELIVERED IN | ORIGINAL Co | OUNTERPARTS | |
|------------|--------------------------|-------------|-------------------------|--|
| this | day of | | 20 | |
| IF THE PRI | NCIPAL IS AN INDIVIDUAL, | SIGN HERE | (Printed or Typed Name) | |
| Witness | { | Principal | { | |
| | (Signature and Date) | | (Signature and Date) | |

IF THE PRINCIPAL IS A PARTNERSHIP, SIGN HERE

| | (Printed or Typed Name) | | (Printed or Typed Name) | |
|---------|--------------------------|----------|-------------------------|--|
| Witness | | Partner* | | |
| | { | | { | |
| | (Signature and Date) | | (Signature and Date) | |
| | | | | |
| | (Printed or Typed Name) | | (Printed or Typed Name) | |
| Witness | (1 randa or 1 ypea rand) | Partner* | | |
| | { | { | | |
| | (Signature and Date) | | (Signature and Date) | |

* If the Bidder is a partnership, the Bond must be signed in the name of the partnership by at least two general partners, whose names and addresses must be listed on the certificate on page BF-3-P of the Bid.

IF THE PRINCIPAL IS A CORPORATION, SIGN HERE

(CORPORATE SEAL)

| | | (C | orporate Name) | |
|---------|-------------------------|---------------------|-------------------------|--|
| | (Printed or Typed Name) | | (Printed or Typed Name) | |
| Witness | { | President V.P.** | { | |
| | (Signature and Date) | | (Signature and Date) | |
| | (Corporate Title) | | (Corporate Title) | |

** If the bidder is a corporation, the Bond must be executed in the Corporation's correct corporate name by its President or Vice President and attested to by its Secretary or Assistant Secretary or Treasurer or Assistant Treasurer, and the Certification of Corporate Principal below must be executed by the Secretary or Assistant Secretary.

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the Secretary/Assistant Secretary of the Corporation named a Bidder herein; that

(Circle one)

who signed this Bid on behalf of the

Corporation was then ______ of said Corporation that I know his signature and his signature thereto is genuine; and that said Bid was duly signed, sealed and attested in behalf of said Corporation by authority of its governing body.

(CORPORATE SEAL)

(Signature and Date)

SURETY SIGN HERE

| (SURET | Y |
|--------|---|
| SEAL) | |

(Printed or Typed Name)

(Printed or Typed Name)

Attest

{

Surety ***

(Signature and Date)

(Signature and Date)

per thousand.

***Power of attorney must be attached to this Bid Bond.

The rate of premium charged is \$_

(To be filled in by Surety)

The total amount of premium charged is \$_

(To be filled in by Surety)

PAYMENT BOND (Labor and Materialmen's Bond)

THIS BOND IS ISSUED SIMULTANEOUSLY WITH PERFORMANCE BOND IN FAVOR OF THE AUTHORITY CONDITIONED ON THE FULL AND FAITHFUL PERFORMANCE OF THE CONTRACT.

KNOW ALL MEN BY THESE PRESENTS, that we,

| | , as Principal, and |
|---|---|
| (Insert name and address of Contractor exactly as it appears on Form of Agreement) | I / |
| | |
| | |
| | , as Sureties, are |
| held and firmly bound unto the Housing Authority of the Cit (the Obligee, hereinafter called the "Authority") in the penal su | • • • |
| | Dollars (\$) |
| lawful money of the United States, for the payment of which heirs, personal representatives, successors, and assigns, jointly | |
| WHEREAS, the Principal heretofore has submitted to the | said Obligee a certain bid, dated |
| , 20 | (the "Bid"), for construction of |
| | |
| (Insert name of project exactly as it appears on Form of Agreement) | |
| pursuant to specifications, drawings and other related documer | its constituting the invitation for Blds (the "IFB"); and |

WHEREAS, the said Authority is a "Contracting body" under provisions of Act No. 385 of the General Assembly of the Commonwealth of Pennsylvania, approved by the Governor on December 20, 1967, known and cited as the "Public Works Contractors' Bond Law of 1967" (8 P.S. 191-202) (the "Act"); and

WHEREAS, the Act, in Section 3 (a), requires that, before an award shall be made to the Principal shall furnish this Bond to the said Authority, with this Bond to become binding upon the award of a Contract to the Principal by the said Authority in accordance with the Bid; and

WHEREAS, it also is a condition of the IFB that this Bond shall be furnished by the Principal to the said Authority; and

WHEREAS, Under the Invitation for Bids, it is provided, inter alia, that if the Principal shall furnish this Bond to the said Authority, and if the said Authority shall make an award to the Principal in accordance with the Bid, then the Principal and the said Authority shall enter into a contract with respect to performance of such work (the "Contract"), the Form of Agreement for which is set forth in the IFB.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if said principal and all subcontractors to whom any portion of the work provided for in said contract is sublet and all assignees of said principal and of such subcontractors shall promptly make payment for all material furnished, labor supplied or performed, rental for equipment employed, and services rendered by public utilities in or in connection with the prosecution of the work, whether or not the said material, labor, equipment or services enter into and become component parts of the work or improvement contemplated in said contract, or in any amendment or extension of or addition to said Contract, then the above obligation shall be void; otherwise to remain in full force and effect. PROVIDED, however, that this bond is subject to the following conditions and limitations.

(a) All persons who have performed labor, rendered services or furnished materials or machinery, shall have direct right of action against the principal and surety on this bond, which right of action shall be asserted in proceedings instituted in the State in which such labor was performed, services rendered or materials furnished (or where labor has been performed, services rendered or materials furnished under said Contract is more than one State, then in any such State). Insofar as permitted by the laws of such State, such right of action shall be asserted in a proceeding instituting such action and any or all other persons having claims hereunder, and any other person having a claim hereunder shall have the right to be made a party to such proceeding (but not later than one year after the complete performance of said Contract and final settlement thereof) and to have such claim adjudicated in such action and judgment rendered thereon.

(b) The surety shall not be liable hereunder for any damages or compensation recoverable under any workmen's compensation or employer's liability statute.

(c) In no event shall the surety be liable for a greater sum than the penalty of this bond, or subject to any suit, action or proceeding thereon that is instituted later than one year after the complete performance of said contract and final settlement thereof.

(d) As used herein: The term "person" refers to any individual, firm or corporation who have furnished materials or machinery or public utility services to be used on or incorporated in the work or the prosecution thereof provided for in said Contract or in any amendment or extension of or addition to said Contract, and/or to any person engaged in the prosecution of the work provided for in said Contract or in any amendment or extension of or addition to said Contract, who is an agent, servant or employee of the principal, or of any subcontractor, or of any assignee of said principal or of any subcontractor and also anyone so engaged who performs the work of a laborer or of a mechanic regardless of any contractual relationship between the principal, or any sub-contractor, or any assignee of said principal or of said subcontractor, and such laborer or mechanic, but shall not include office employees not regularly stationed at the site of the work.

The said surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract, or to the work to be performed thereunder or the Specifications accompanying the same, shall in any wise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the Specifications.

| SIGNED, SE | ALED AND DELIVERED IN(2 require | ORIGINAL CO | UNTERPARTS | |
|------------|---------------------------------|-------------|-------------------------|--|
| this | day of | | 20 | |
| IF THE PRI | NCIPAL IS AN INDIVIDUAL, S | SIGN HERE | | |
| | (Printed or Typed Name) | | (Printed or Typed Name) | |
| Witness | { | Principal | { | |
| | (Signature and Date) | | (Signature and Date) | |

IF THE PRINCIPAL IS A PARTNERSHIP, SIGN HERE

| | (Printed or Typed Name) | | | (Printed or Typed Name) | |
|---------|-------------------------|----------|---|-------------------------|--|
| Witness | | Partner* | | | |
| | { | | { | | |
| | (Signature and Date) | | | (Signature and Date) | |
| | | | | | |
| | | | | | |
| | (Printed or Typed Name) | | | (Printed or Typed Name) | |
| Witness | | Partner* | | | |
| | { | { | | | |
| | (Signature and Date) | | | (Signature and Date) | |

* If the Bidder is a partnership, the Bond must be signed in the name of the partnership by at least two general partners, whose names and addresses must be listed on the certificate on page BF-3-P of the Bid.

IF THE PRINCIPAL IS A CORPORATION, SIGN HERE

(CORPORATE SEAL)

| | | īC | 'orporate Name) | |
|---------|-------------------------|---------------------|-------------------------|--|
| | (Printed or Typed Name) | | (Printed or Typed Name) | |
| Witness | { | President V.P.** | { | |
| | (Signature and Date) | | (Signature and Date) | |
| | (Corporate Title) | | (Corporate Title) | |

** If the bidder is a corporation, the Bond must be executed in the Corporation's correct corporate name by its President or Vice President and attested to by its Secretary or Assistant Secretary or Treasurer or Assistant Treasurer, and the Certification of Corporate Principal (Doc. 00625) must be executed by the Secretary or Assistant Secretary.

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the Secretary/Assistant Secretary of the Corporation named a Bidder herein; that (Circle one)

who signed this Bid on behalf of the

Corporation was then ______ of said Corporation that I know his signature and his signature thereto is genuine; and that said Bid was duly signed, sealed and attested in behalf of said Corporation by authority of its governing body.

(CORPORATE SEAL)

(Signature and Date)

| SURETY SI | GN HERE | | | |
|------------------|--|-----------------------------|-------------------------|--|
| (SURETY SEAL) | | | | |
| | (Printed or Typed Name) | | (Printed or Typed Name) | |
| Attest | | Surety | | |
| | { | | { | |
| | { { { [Signature and Date] } [Signature and Date] } [Signature and Date] } [Signature and Date] [Signature and Dat | | | |
| | | | | |
| The rate of p | remium charged is \$(To be file | led in by Surety) | per thousand. | |
| The total amo | ount of premium charged is \$ | (To be filled in by Surety) | | |



Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP Contract No. 600-19-21

SUPPLEMENTAL GENERAL CONDITIONS

SUPPLEMENTAL GENERAL CONDITIONS

To the extent that there is a conflict between the terms of the General Conditions and the terms of the Supplemental General Conditions, the terms of the Supplemental General Conditions shall govern to the extent of such conflict.

If HUD 5370 applies:

Section 31(e) of the General Conditions shall be deleted in its entirety and replaced by the following:

31(e). Forum. The Contracting Officer's decision shall be final unless, within thirty (30) days of receipt of the Contracting Officer's decision, the Contractor files suit in a court of competent jurisdiction.

If HUD 5370-EZ applies:

Section 3(d) of the General Conditions shall be deleted in its entirety and replaced by the following:

31(d). Forum. The Contracting Officer's decision shall be final unless, within thirty (30) days of receipt of the Contracting Officer's decision, the Contractor files suit in a court of competent jurisdiction.

If HUD 5370-C applies:

Section 1 Item 7(d) of the General Conditions shall be deleted in its entirety and replaced by the following:

Section 1 Item 7(d). Forum. The Contracting Officer's decision shall be final unless, within thirty (30) days of receipt of the Contracting Officer's decision, the Contractor files suit in a court of competent jurisdiction.

HOUSING AUTHORITY OF THE CITY OF PITTSBURGH

Date: ______ Signature: ______Contracting Officer _______
Vendor Name(Insert vendor company name above)
Date: ______ Signature: ______
Title: ______

General Conditions for Construction Contracts - Public Housing Programs

U.S. Department of Housing and UrbanDev elopment Office of Public and Indian Housing OMB Approval No. 2577-0157 (exp. 11/30/2023)

Applicability. This form is applicable to any construction/development contract greater than \$150,000.

Public reporting burden for this collection of information is estimated to average 1 hour. This includes the time for collecting, reviewing, and reporting the data. The information requested is required to obtain a benefit. This form includes those clauses required by OMB's common rule on grantee procurement, implemented at HUD in 2 CFR 200, and those requirements set forth in Section 3 of the Housing and Urban Development Act of 1968 and its amendment by the Housing and Community Development Act of 1992, implemented by HUD at 24 CFR Part 135. The form is required for construction contracts awarded by Public Housing Agencies (PHAs). The form is used by Housing Authorities in solicitations to provide necessary contract clauses. If the form were not used, PHAs would be unable to enforce their contracts... There are no assurances of confidentiality. HUD may not conduct or sponsor, and an applicant is not required to respond to a collection of information unless it displays a currently valid OMB control number.

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1. Definitions

- (a) "Architect" means the person or other entity engaged by the PHA to perform architectural, engineering, design, and other services related to the work as provided for in the contract. When a PHA uses an engineer to act in this capacity, the terms "architect" and "engineer" shall be synonymous. The Architect shall serve as a technical representative of the Contracting Officer. The Architect's authority is as set forth elsewhere in this contract.
- (b) "Contract" means the contract entered into between the PHA and the Contractor. It includes the forms of Bid, the Bid Bond, the Performance and Payment Bond or Bonds or other assurance of completion, the Certifications, Representations, and Other Statements of Bidders (form HUD-5370), these General Conditions of the Contract for Construction (form HUD-5370), the applicable wage rate determinations from the U.S. Department of Labor, any special conditions included elsewhere in the contract, the specifications, and drawings. It includes all formal changes to any of those documents by addendum, change order, or other modification.
- (c) "Contracting Officer" means the person delegated the authority by the PHA to enter into, administer, and/or terminate this contract and designated as such in writing to the Contractor. The term includes any successor Contracting Officer and any duly authorized representative of the Contracting Officer also designated in writing. The Contracting Officer shall be deemed the authorized agent of the PHA in all dealings with the Contractor.
- (d) "Contractor" means the person or other entity entering into the contract with the PHA to perform all of the work required under the contract.
- (e) "Drawings" means the drawings enumerated in the schedule of drawings contained in the Specifications and as described in the contract clause entitled Specifications and Drawings for Construction herein.
- (f) "HUD" means the United States of America acting through the Department of Housing and Urban Development including the Secretary, or any other person designated to act on its behalf. HUD has agreed, subject to the provisions of an Annual Contributions Terms and Conditions (ACC), to provide financial assistance to the PHA, which includes assistance in financing the work to be performed under this contract. As defined elsewhere in these General Conditions or the contract documents, the determination of HUD may be required to authorize changes in the work or for release of funds to the PHA for payment to the Contractor. Notwithstanding HUD's role, nothing in this contract shall be construed to create any contractual relationship between the Contractor and HUD.
- (g) "Project" means the entire project, whether construction or rehabilitation, the work for which is provided for in whole or in part under this contract.
- (h) "PHA" means the Public Housing Agency organized under applicable state laws which is a party to this contract.
- (j) "Specifications" means the written description of the technical requirements for construction and includes the criteria and tests for determining whether the requirements are met.
- (I) "Work" means materials, workmanship, and manufacture and fabrication of components.

2. Contractor's Responsibility for Work

- (a) The Contractor shall furnish all necessary labor, materials, tools, equipment, and transportation necessary for performance of the work. The Contractor shall also furnish all necessary water, heat, light, and power not made available to the Contractor by the PHA pursuant to the clause entitled Availability and Use of Utility Services herein.
- (b) The Contractor shall perform on the site, and with its own organization, work equivalent to at least [X] (12 percent unless otherwise indicated) of the total amount of work to be performed under the order. This percentage may be reduced by a supplemental agreement to this order if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the PHA.
- (c) At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the work site a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.
- (d) The Contractor shall be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence, and shall take proper safety and health precautions to protect the work, the workers, the public, and the property of others. The Contractor shall hold and save the PHA, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.
- (e) The Contractor shall lay out the work from base lines and bench marks indicated on the drawings and be responsible for all lines, levels, and measurements of all work executed under the contract. The Contractor shall verify the figures before laying out the work and will be held responsible for any error resulting from its failure to do so.
- (f) The Contractor shall confine all operations (including storage of materials) on PHA premises to areas authorized or approved by the Contracting Officer.
- (g) The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. After completing the work and before final inspection, the Contractor shall (1) remove from the premises all scaffolding, equipment, tools, and materials (including rejected materials) that are not the property of the PHA and all rubbish caused by its work; (2) leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer; (3) perform all specified tests; and, (4) deliver the installation in complete and operating condition.
- (h) The Contractor's responsibility will terminate when all work has been completed, the final inspection made, and the work accepted by the Contracting Officer. The Contractor will then be released from further obligation except as required by the warranties specified elsewhere in the contract.

3. Architect's Duties, Responsibilities, and Authority

(a) The Architect for this contract, and any successor, shall be designated in writing by the Contracting Officer.

- (b) The Architect shall serve as the Contracting Officer's technical representative with respect to architectural, engineering, and design matters related to the work performed under the contract. The Architect may provide direction on contract performance. Such direction shall be within the scope of the contract and may not be of a nature which: (1) institutes additional work outside the scope of the contract; (2) constitutes a change as defined in the Changes clause herein; (3) causes an increase or decrease in the cost of the contract; (4) alters the Construction Progress Schedule; or (5) changes any of the other express terms or conditions of the contract.
- (c) The Architect's duties and responsibilities may include but shall not be limited to:
 - (1) Making periodic visits to the work site, and on the basis of his/her on-site inspections, issuing written reports to the PHA which shall include all observed deficiencies. The Architect shall file a copy of the report with the Contractor's designated representative at the site;
 - (2) Making modifications in drawings and technical specifications and assisting the Contracting Officer in the preparation of change orders and other contract modifications for issuance by the Contracting Officer;
 - (3) Reviewing and making recommendations with respect to - (i) the Contractor's construction progress schedules; (ii) the Contractor's shop and detailed drawings; (iii) the machinery, mechanical and other equipment and materials or other articles proposed for use by the Contractor; and, (iv) the Contractor's price breakdown and progress payment estimates; and,
 - (4) Assisting in inspections, signing Certificates of Completion, and making recommendations with respect to acceptance of work completed under the contract.

4. Other Contracts

The PHA may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with PHA employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by PHA employees

Construction Requirements

5. Pre-construction Conference and Notice to Proceed

- (a) Within ten calendar days of contract execution, and prior to the commencement of work, the Contractor shall attend a preconstruction conference with representatives of the PHA, its Architect, and other interested parties convened by the PHA. The conference will serve to acquaint the participants with the general plan of the construction operation and all other requirements of the contract. The PHA will provide the Contractor with the date, time, and place of the conference.
- (b) The contractor shall begin work upon receipt of a written Notice to Proceed from the Contracting Officer or designee. The Contractor shall not begin work prior to receiving such notice.

6. Construction Progress Schedule

- (a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring labor, materials, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments or take other remedies under the contract until the Contractor submits the required schedule.
- (b) The Contractor shall enter the actual progress on the chart as required by the Contracting Officer, and immediately deliver three copies of the annotated schedule to the Contracting Officer. If the Contracting Officer determines, upon the basis of inspection conducted pursuant to the clause entitled Inspection and Acceptance of Construction, herein that the Contractor is not meeting the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the PHA. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.
- (c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the Contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the Default clause of this contract.

7. Site Investigation and Conditions Affecting the Work

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to, (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and roads;(3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is

reasonably ascertainable from an inspection of the site, including all exploratory work done by the PHA, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the PHA.

(b) The PHA assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the PHA. Nor does the PHA assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

8. Differing Site Conditions

- (a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of (1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or (2) unknown physical conditions at the site(s), of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.
- (b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. Work shall not proceed at the affected site, except at the Contractor's risk, until the Contracting Officer has provided written instructions to the Contractor. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, the Contractor shall file a claim in writing to the PHA within ten days after receipt of such instructions and, in any event, before proceeding with the work. An equitable adjustment in the contract price, the delivery schedule, or both shall be made under this clause and the contract modified in writing accordingly.
- (c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.
- (d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

9. Specifications and Drawings for Construction

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

- (b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by", or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.
- (c) Where "as shown" "as indicated", "as detailed", or words
- of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place" that is "furnished and installed".
- (d) "Shop drawings" means drawings, submitted to the PHA by the Contractor, subcontractor, or any lower tier subcontractor, showing in detail (1) the proposed fabrication and assembly of structural elements and (2) the installation (i.e., form, fit, and attachment details) of materials of equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the contract. The PHA may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.
- (e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with other contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the PHA's reasons therefore. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.
- (f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Architect approves any such variation and the Contracting Officer concurs, the Contracting Officer shall issue an appropriate modification to the contract, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.
- (g) It shall be the responsibility of the Contractor to make timely requests of the PHA for such large scale and full size drawings, color schemes, and other additional information, not already in his possession, which shall be

required in the planning and production of the work. Such requests may be submitted as the need arises, but each such request shall be filed in ample time to permit appropriate action to be taken by all parties involved so as to avoid delay.

- (h) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the PHA and one set will be returned to the Contractor. As required by the Contracting Officer, the Contractor, upon completing the work under this contract, shall furnish a complete set of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the work is completed and accepted.
- (i) This clause shall be included in all subcontracts at any tier. It shall be the responsibility of the Contractor to ensure that all shop drawings prepared by subcontractors are submitted to the Contracting Officer.
- 10. As-Built Drawings
- (a) "As-built drawings," as used in this clause, means drawings submitted by the Contractor or subcontractor at any tier to show the construction of a particular structure or work as actually completed under the contract. "As-built drawings" shall be synonymous with "Record drawings."
- (b) As required by the Contracting Officer, the Contractor shall provide the Contracting Officer accurate information to be used in the preparation of permanent as-built drawings. For this purpose, the Contractor shall record on one set of contract drawings all changes from the installations originally indicated, and record final locations of underground lines by depth from finish grade and by accurate horizontal offset distances to permanent surface improvements such as buildings, curbs, or edges of walks.
- (c) This clause shall be included in all subcontracts at any tier. It shall be the responsibility of the Contractor to ensure that all as-built drawings prepared by subcontractors are submitted to the Contracting Officer.
- 11. Material and Workmanship
- (a) All equipment, material, and articles furnished under this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the contract to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of, and as approved by the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.
- (b) Approval of equipment and materials.
 - (1) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the

machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

- (2) When required by the specifications or the Contracting Officer, the Contractor shall submit appropriately marked samples (and certificates related to them) for approval at the Contractor's expense, with all shipping charges prepaid. The Contractor shall label, or otherwise properly mark on the container, the material or product represented, its place of origin, the name of the producer, the Contractor's name, and the identification of the construction project for which the material or product is intended to be used.
- (3) Certificates shall be submitted in triplicate, describing each sample submitted for approval and certifying that the material, equipment or accessory complies with contract requirements. The certificates shall include the name and brand of the product, name of manufacturer, and the location where produced.
- (4) Approval of a sample shall not constitute a waiver of the PHA right to demand full compliance with contract requirements. Materials, equipment and accessories may be rejected for cause even though samples have been approved.
- (5) Wherever materials are required to comply with recognized standards or specifications, such specifications shall be accepted as establishing the technical qualities and testing methods, but shall not govern the number of tests required to be made nor modify other contract requirements. The Contracting Officer may require laboratory test reports on items submitted for approval or may approve materials on the basis of data submitted in certificates with samples. Check tests will be made on materials delivered for use only as frequently as the Contracting Officer determines necessary to insure compliance of materials with the specifications. The Contractor will assume all costs of retesting materials which fail to meet contract requirements and/or testing materials offered in substitution for those found deficient.
- (6) After approval, samples will be kept in the Project office until completion of work. They may be built into the work after a substantial quantity of the materials they represent has been built in and accepted.
- (c) Requirements concerning lead-based paint. The Contractor shall comply with the requirements concerning lead-based paint contained in the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. 4821-4846) as implemented by 24 CFR Part 35.
- 12. Permits and Codes
- (a) The Contractor shall give all notices and comply with all applicable laws, ordinances, codes, rules and regulations. Notwithstanding the requirement of the Contractor to comply with the drawings and specifications in the contract, all work installed shall comply with all applicable codes and regulations as amended by any

waivers. Before installing the work, the Contractor shall examine the drawings and the specifications for compliance with applicable codes and regulations bearing on the work and shall immediately report any discrepancy it may discover to the Contracting Officer. Where the requirements of the drawings and specifications fail to comply with the applicable code or regulation, the Contracting Officer shall modify the contract by change order pursuant to the clause entitled Changes herein to conform to the code or regulation.

- (b) The Contractor shall secure and pay for all permits, fees, and licenses necessary for the proper execution and completion of the work. Where the PHA can arrange for the issuance of all or part of these permits, fees and licenses, without cost to the Contractor, the contract amount shall be reduced accordingly.
- 13. Health, Safety, and Accident Prevention
- (a) In performing this contract, the Contractor shall:
 - (1) Ensure that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his/her health and/or safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation;
 - (2) Protect the lives, health, and safety of other persons;
 - (3) Prevent damage to property, materials, supplies, and equipment; and,
 - (4) Avoid work interruptions.
- (b) For these purposes, the Contractor shall:
 - (1) Comply with regulations and standards issued by the Secretary of Labor at 29 CFR Part 1926. Failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (Public Law 91-54, 83 Stat. 96), 40 U.S.C. 3701 et seq.; and
 - (2) Include the terms of this clause in every subcontract so that such terms will be binding on each subcontractor.
- (c) The Contractor shall maintain an accurate record of exposure data on all accidents incident to work performed under this contract resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment, and shall report this data in the manner prescribed by 29 CFR Part 1904.
- (d) The Contracting Officer shall notify the Contractor of any noncompliance with these requirements and of the corrective action required. This notice, when delivered to the Contractor or the Contractor's representative at the site of the work, shall be deemed sufficient notice of the noncompliance and corrective action required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to take corrective action promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not base any claim or request for equitable adjustment for additional time or money on any stop order issued under these circumstances.
- (e) The Contractor shall be responsible for its subcontractors' compliance with the provisions of this clause. The Contractor shall take such action with respect to any subcontract as the PHA, the Secretary of Housing and Urban Development, or the Secretary of Labor shall direct as a means of enforcing such provisions.

14. Temporary Heating

The Contractor shall provide and pay for temporary heating, covering, and enclosures necessary to properly protect all work and materials against damage by dampness and cold, to dry out the work, and to facilitate the completion of the work. Any permanent heating equipment used shall be turned over to the PHA in the condition and at the time required by the specifications.

- 15. Availability and Use of Utility Services
- (a) The PHA shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the PHA or, where the utility is produced by the PHA, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.
- (b) The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the PHA, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- 16. Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements
- (a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed under this contract, and which do not unreasonably interfere with the work required under this contract.
- (b) The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during performance of this contract, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.
- (c) The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site and (2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. Prior to disturbing the ground at the construction site, the Contractor shall ensure that all underground utility lines are clearly marked.
- (d) The Contractor shall shore up, brace, underpin, secure, and protect as necessary all foundations and other parts of existing structures adjacent to, adjoining, and in the vicinity of the site, which may be affected by the excavations or other operations connected with the construction of the project.
- (e) Any equipment temporarily removed as a result of work under this contract shall be protected, cleaned, and replaced in the same condition as at the time of award of this contract.

- (f) New work which connects to existing work shall correspond in all respects with that to which it connects and/or be similar to existing work unless otherwise required by the specifications.
- (g) No structural members shall be altered or in any way weakened without the written authorization of the Contracting Officer, unless such work is clearly specified in the plans or specifications.
- (h) If the removal of the existing work exposes discolored or unfinished surfaces, or work out of alignment, such surfaces shall be refinished, or the material replaced as necessary to make the continuous work uniform and harmonious. This, however, shall not be construed to require the refinishing or reconstruction of dissimilar finishes previously exposed, or finished surfaces in good condition, but in different planes or on different levels when brought together by the removal of intervening work, unless such refinishing or reconstruction is specified in the plans or specifications.
- (i) The Contractor shall give all required notices to any adjoining or adjacent property owner or other party before the commencement of any work.
- (j) The Contractor shall indemnify and save harmless the PHA from any damages on account of settlement or the loss of lateral support of adjoining property, any damages from changes in topography affecting drainage, and from all loss or expense and all damages for which the PHA may become liable in consequence of such injury or damage to adjoining and adjacent structures and their premises.
- (k) The Contractor shall repair any damage to vegetation, structures, equipment, utilities, or improvements, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

17. Temporary Buildings and Transportation of Materials

- (a) Temporary buildings (e.g., storage sheds, shops, offices, sanitary facilities) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the PHA. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.
- (b) The Contractor shall, as directed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any federal, state, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

18. Clean Air and Water

The contactor shall comply with the Clean Air Act, as amended, 42 USC 7401 et seq., the Federal Water Pollution Control Water Act, as amended, 33 U.S.C. 1251 et seq., and standards issued pursuant thereto in the facilities in which this contract is to be performed.

19. Energy Efficiency

The Contractor shall comply with mandatory standards and policies relating to energy efficiency which are contained in the energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub.L. 94-163) for the State in which the work under the contract is performed.

20. Inspection and Acceptance of Construction

- (a) Definitions. As used in this clause -
 - (1) "Acceptance" means the act of an authorized representative of the PHA by which the PHA approves and assumes ownership of the work performed under this contract. Acceptance may be partial or complete.

(2) "Inspection" means examining and testing the work performed under the contract (including, when appropriate, raw materials, equipment, components, and intermediate assemblies) to determine whether it conforms to contract requirements.

(3) "Testing" means that element of inspection that determines the properties or elements, including functional operation of materials, equipment, or their components, by the application of established scientific principles and procedures.

- (b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. All work is subject to PHA inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.
- (c) PHA inspections and tests are for the sole benefit of the PHA and do not: (1) relieve the Contractor of responsibility for providing adequate quality control measures; (2) relieve the Contractor of responsibility for loss or damage of the material before acceptance; (3) constitute or imply acceptance; or, (4) affect the continuing rights of the PHA after acceptance of the completed work under paragraph (j) below.
- (d) The presence or absence of the PHA inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specifications without the Contracting Officer's written authorization. All instructions and approvals with respect to the work shall be given to the Contractor by the Contracting Officer.
- (e) The Contractor shall promptly furnish, without additional charge, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The PHA may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The PHA shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

- (f) The PHA may conduct routine inspections of the construction site on a daily basis.
- (g) The Contractor shall, without charge, replace or correct work found by the PHA not to conform to contract requirements, unless the PHA decides that it is in its interest to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.
- (h) If the Contractor does not promptly replace or correct rejected work, the PHA may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor, or (2) terminate for default the Contractor's right to proceed.
- (i) If any work requiring inspection is covered up without approval of the PHA, it must, if requested by the Contracting Officer, be uncovered at the expense of the Contractor. If at any time before final acceptance of the entire work, the PHA considers it necessary or advisable, to examine work already completed by removing or tearing it out, the Contractor, shall on request, promptly furnish all necessary facilities, labor, and material. If such work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray all the expenses of the examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the contract, the Contracting Officer shall make an equitable adjustment to cover the cost of the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.
- (j) The Contractor shall notify the Contracting Officer, in writing, as to the date when in its opinion all or a designated portion of the work will be substantially completed and ready for inspection. If the Architect determines that the state of preparedness is as represented, the PHA will promptly arrange for the inspection. Unless otherwise specified in the contract, the PHA shall accept, as soon as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines and designates can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the PHA's right under any warranty or guarantee.

21. Use and Possession Prior to Completion

- (a) The PHA shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the PHA intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The PHA's possession or use shall not be deemed an acceptance of any work under the contract.
- (b) While the PHA has such possession or use, the Contractor shall be relieved of the responsibility for (1) the loss of or damage to the work resulting from the PHA's possession or use, notwithstanding the terms of the clause entitled Permits and Codes herein; (2) all maintenance costs on the areas occupied; and, (3) furnishing heat, light, power, and water used in the areas

occupied without proper remuneration therefore. If prior possession or use by the PHA delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

22. Warranty of Title

The Contractor warrants good title to all materials, supplies, and equipment incorporated in the work and agrees to deliver the premises together with all improvements thereon free from any claims, liens or charges, and agrees further that neither it nor any other person, firm or corporation shall have any right to a lien upon the premises or anything appurtenant thereto.

23. Warranty of Construction

- (a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (j) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or workmanship performed by the Contractor or any subcontractor or supplier at any tier. This warranty shall continue for a period of (one year unless otherwise indicated) from the date of final acceptance of the work. If the PHA takes possession of any part of the work before final acceptance, this warranty shall continue for a period of (one year unless otherwise indicated) from the date that the PHA takes possession.
- (b) The Contractor shall remedy, at the Contractor's expense, any failure to conform, or any defect. In addition, the Contractor shall remedy, at the Contractor's expense, any damage to PHA-owned or controlled real or personal property when the damage is the result of—
 - The Contractor's failure to conform to contract requirements; or
 - (2) Any defects of equipment, material, workmanship or design furnished by the Contractor.
- (c) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for (one year unless otherwise indicated) from the date of repair or replacement.
- (d) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect or damage.
- (e) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the PHA shall have the right to replace, repair or otherwise remedy the failure, defect, or damage at the Contractor's expense.
- (f) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall:
 - (1) Obtain all warranties that would be given in normal commercial practice;
 - (2) Require all warranties to be executed in writing, for the benefit of the PHA; and,
 - (3) Enforce all warranties for the benefit of the PHA.
- (g) In the event the Contractor's warranty under paragraph (a) of this clause has expired, the PHA may bring suit at its own expense to enforce a subcontractor's, manufacturer's or supplier's warranty.

- (h) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defect of material or design furnished by the PHA nor for the repair of any damage that results from any defect in PHA furnished material or design.
- (i) Notwithstanding any provisions herein to the contrary, the establishment of the time periods in paragraphs (a) and (c) above relate only to the specific obligation of the Contractor to correct the work, and have no relationship to the time within which its obligation to comply with the contract 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 its obligation other than specifically to correct the work.
- (j) This warranty shall not limit the PHA's rights under the Inspection and Acceptance of Construction clause of this contract with respect to latent defects, gross mistakes or fraud.
- 24. Prohibition Against Liens

The Contractor is prohibited from placing a lien on the PHA's property. This prohibition shall apply to all subcontractors at any tier and all materials suppliers.

Administrative Requirements

25. Contract Period

this contract within 120 calendar days of the effective date of the contract, or within the time schedule established in the notice to proceed issued by the Contracting Officer.

26. Order of Provisions

In the event of a conflict between these General Conditions and the Specifications, the General Conditions shall prevail. In the event of a conflict between the contract and any applicable state or local law or regulation, the state or local law or regulation shall prevail; provided that such state or local law or regulation does not conflict with, or is less restrictive than applicable federal law, regulation, or Executive Order. In the event of such a conflict, applicable federal law, regulation, and Executive Order shall prevail.

27. Payments

- (a) The PHA shall pay the Contractor the price as provided in this contract.
- (b) The PHA shall make progress payments approximately every 30 days as the work proceeds, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer. The PHA may, subject to written determination and approval of the Contracting Officer, make more frequent payments to contractors which are qualified small businesses.
- (c) Before the first progress payment under this contract, the Contractor shall furnish, in such detail as requested by the Contracting Officer, a breakdown of the total contract price showing the amount included therein for each principal category of the work, which shall substantiate the payment amount requested in order to provide a

basis for determining progress payments. The breakdown shall be approved by the Contracting Officer and must be acceptable to HUD. If the contract covers more than one project, the Contractor shall furnish a separate breakdown for each. The values and quantities employed in making up this breakdown are for determining the amount of progress payments and shall not be construed as a basis for additions to or deductions from the contract price. The Contractor shall prorate its overhead and profit over the construction period of the contract.

(d) The Contractor shall submit, on forms provided by the PHA, periodic estimates showing the value of the work performed during each period based upon the approved

submitted not later than 45 days in advance of the date set for payment and are subject to correction and revision as required. The estimates must be approved by the Contracting Officer with the concurrence of the Architect prior to payment. If the contract covers more than one project, the Contractor shall furnish a separate progress payment estimate for each.

- (e) Along with each request for progress payments and the required estimates, the Contractor shall furnish the following certification, or payment shall not be made: I hereby certify, to the best of my knowledge and belief, that:
 - The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;
 - (2) Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements; and,
 - (3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.

Name:

Title:

Date:

- (f) Except as otherwise provided in State law, the PHA shall retain ten (10) percent of the amount of progress payments until completion and acceptance of all work under the contract; except, that if upon completion of 50 percent of the work, the Contracting Officer, after consulting with the Architect, determines that the Contractor's performance and progress are satisfactory, the PHA may make the remaining payments in full for the work subsequently completed. If the Contracting Officer subsequently determines that the Contractor's performance and progress are unsatisfactory, the PHA shall reinstate the ten (10) percent (or other percentage as provided in State law) retainage until such time as the Contracting Officer determines that performance and progress are satisfactory.
- (g) The Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration when computing progress payments.

Material delivered to the Contractor at locations other than the site may also be taken into consideration if the Contractor furnishes satisfactory evidence that (1) it has acquired title to such material; (2) the material is properly stored in a bonded warehouse, storage yard, or similar suitable place as may be approved by the Contracting Officer; (3) the material is insured to cover its full value; and (4) the material will be used to perform this contract. Before any progress payment which includes delivered material is made, the Contractor shall furnish such documentation as the Contractor shall furnish such materials. The Contractor shall remain responsible for such stored material notwithstanding the transfer of title to the PHA.

- (h) All material and work covered by progress payments made shall, at the time of payment become the sole property of the PHA, but this shall not be construed as (1) relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or, (2) waiving the right of the PHA to require the fulfillment of all of the terms of the contract. In the event the work of the Contractor has been damaged by other contractors or persons other than employees of the PHA in the course of their employment, the Contractor shall restore such damaged work without cost to the PHA and to seek redress for its damage only from those who directly
- caused it.
- (i) The PHA shall make the final payment due the Contractor under this contract after (1) completion and final acceptance of all work; and (2) presentation of release of all claims against the PHA arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. Each such exception shall embrace no more than one claim, the basis and scope of which shall be clearly defined. The amounts for such excepted claims shall not be included in the request for final payment. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned.
- (j) Prior to making any payment, the Contracting Officer may require the Contractor to furnish receipts or other evidence of payment from all persons performing work and supplying material to the Contractor, if the Contracting Officer determines such evidence is necessary to substantiate claimed costs.
- (k) The PHA shall not; (1) determine or adjust any claims for payment or disputes arising there under between the Contractor and its subcontractors or material suppliers; or, (2) withhold any moneys for the protection of the subcontractors or material suppliers. The failure or refusal of the PHA to withhold moneys from the Contractor shall in nowise impair the obligations of any surety or sureties under any bonds furnished under this contract.

28. Contract Modifications

- (a) Only the Contracting Officer has authority to modify any term or condition of this contract. Any contract modification shall be authorized in writing.
- (b) The Contracting Officer may modify the contract unilaterally (1) pursuant to a specific authorization stated in a contract clause (e.g., Changes); or (2) for administrative matters which do not change the rights or

responsibilities of the parties (e.g., change in the PHA address). All other contract modifications shall be in the form of supplemental agreements signed by the Contractor and the Contracting Officer.

(c) When a proposed modification requires the approval of HUD prior to its issuance (e.g., a change order that exceeds the PHA's approved threshold), such modification shall not be effective until the required approval is received by the PHA.

29. Changes

- (a) The Contracting Officer may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract including changes:
 (1) In the specifications (including drawings and designs);
 (2) In the method or manner of performance of the work;
 (3) PHA-furnished facilities, equipment, materials,
 - services, or site; or,(4) Directing the acceleration in the performance of the
- work.
 (b) Any other written order or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating (1) the date, circumstances and source of the order and (2) that the Contractor regards the order as a change order.
- (c) Except as provided in this clause, no order, statement or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.
- (d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for a adjustment based on defective specifications, no proposal for any change under paragraph (b) above shall be allowed for any costs incurred more than 20 days (5 days for oral orders) before the Contractor gives written notice as required. In the case of defective specifications for which the PHA is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.
- (e) The Contractor must assert its right to an adjustment under this clause within 30 days after (1) receipt of a written change order under paragraph (a) of this clause, or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting a written statement describing the general nature and the amount of the proposal. If the facts justify it, the Contracting Officer may extend the period for submission. The proposal may be included in the notice required under paragraph (b) above. No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.
- (f) The Contractor's written proposal for equitable adjustment shall be submitted in the form of a lump sum proposal supported with an itemized breakdown of all increases and decreases in the contract in at least the following details:

- (1) Direct Costs. Materials (list individual items, the quantity and unit cost of each, and the aggregate cost); Transportation and delivery costs associated with materials; Labor breakdowns by hours or unit costs (identified with specific work to be performed); Construction equipment exclusively necessary for the change; Costs of preparation and/ or revision to shop drawings resulting from the change; Worker's Compensation and Public Liability Insurance; Employment taxes under FICA and FUTA; and, Bond Costs when size of change warrants revision.
- (2)Indirect Costs. Indirect costs may include overhead, general and administrative expenses, and fringe benefits not normally treated as direct costs.
- (3)Profit. The amount of profit shall be negotiated and may vary according to the nature, extent, and complexity of the work required by the change. The allowability of the direct and indirect costs shall be determined in accordance with the Contract Cost Principles and Procedures for Commercial Firms in Part 31 of the Federal Acquisition Regulation (48 CFR 1-31), as implemented by HUD Handbook 2210.18, in effect on the date of this contract. The Contractor shall not be allowed a profit on the profit received by any subcontractor. Equitable adjustments for deleted work shall include a credit for profit and may include a credit for indirect costs. On proposals covering both increases and decreases in the amount of the contract, the application of indirect costs and profit shall be on the net-change in direct costs for the Contractor or subcontractor performing the work.
- (g) The Contractor shall include in the proposal its request for time extension (if any), and shall include sufficient information and dates to demonstrate whether and to what extent the change will delay the completion of the contract in its entirety.
- (h) The Contracting Officer shall act on proposals within 30 days after their receipt, or notify the Contractor of the date when such action will be taken.
- (i) Failure to reach an agreement on any proposal shall be a dispute under the clause entitled Disputes herein. Nothing in this clause, however, shall excuse the Contractor from proceeding with the contract as changed.
- (j) Except in an emergency endangering life or property, no change shall be made by the Contractor without a prior order from the Contracting Officer.

30. Suspension of Work

- (a) The Contracting Officer may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the PHA.
- (b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified (or within a reasonable time if not specified) in this contract an adjustment shall be made for any increase in the cost of performance of the contract (excluding profit) necessarily caused by such unreasonable suspension, delay, or interruption and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have

been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor or for which any equitable adjustment is provided for or excluded under any other provision of this contract.

(c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order); and, (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

31. Disputes

- (a) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to the contract. A claim arising under the contract, unlike a claim relating to the contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim. The submission may be converted to a claim by complying with the requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.
- (b) Except for disputes arising under the clauses entitled Labor Standards - Davis Bacon and Related Acts, herein, all disputes arising under or relating to this contract, including any claims for damages for the alleged breach thereof which are not disposed of by agreement, shall be resolved under this clause.
- (c) All claims by the Contractor shall be made in writing and submitted to the Contracting Officer for a written decision. A claim by the PHA against the Contractor shall be subject to a written decision by the Contracting Officer.
- (d) The Contracting Officer shall, within 60 (unless otherwise indicated) days after receipt of the request, decide the claim or notify the Contractor of the date by which the decision will be made.
- (e) The Contracting Officer's decision shall be final unless the Contractor (1) appeals in writing to a higher level in the PHA in accordance with the PHA's policy and procedures, (2) refers the appeal to an independent mediator or arbitrator, or (3) files suit in a court of competent jurisdiction. Such appeal must be made within (30 unless otherwise indicated) days after receipt of the Contracting Officer's decision.
- (f) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under or relating to the contract, and comply with any decision of the Contracting Officer.

32. Default

(a) If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with the diligence that will insure its completion within the time specified in this contract, or any extension thereof, or fails to complete said work within this time, the Contracting Officer may, by written notice to the Contractor, terminate the right to proceed with the work (or separable part of the work) that has been delayed. In this event, the PHA may take over the work and complete it, by contract or otherwise, and may take possession of and use any materials, equipment, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the PHA resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the PHA in completing the work.

- (b) The Contractor's right to proceed shall not be terminated or the Contractor charged with damages under this clause if—
 - (1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include (i) acts of God, or of the public enemy, (ii) acts of the PHA or other governmental entity in either its sovereign or contractual capacity, (iii) acts of another contractor in the performance of a contract with the PHA, (iv) fires, (v) floods, (vi) epidemics, (vii) quarantine restrictions, (viii) strikes, (ix) freight embargoes, (x) unusually severe weather, or (xi) delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and
 - (2) The Contractor, within days (10 days unless otherwise indicated) from the beginning of such delay (unless extended by the Contracting Officer) notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of the delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, time for completing the work shall be extended by written modification to the contract. The findings of the Contracting Officer shall be reduced to a written decision which shall be subject to the provisions of the Disputes clause of this contract.
- (c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been for convenience of the PHA.

33. Liquidated Damages

- (a) If the Contractor fails to complete the work within the time specified in the contract, or any extension, as specified in the clause entitled Default of this contract, the Contractor shall pay to the PHA as liquidated damages, the sum of \$ 150 Contracting Officer insert amount] for each day of delay. If different completion dates are specified in the contract for separate parts or stages of the work, the amount of liquidated damages shall be assessed on those parts or stages which are delayed. To the extent that the Contractor's delay or nonperformance is excused under another clause in this contract, liquidated damages shall not be due the PHA. The Contractor remains liable for damages caused other than by delay.
- (b) If the PHA terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final

completion of the work together with any increased costs occasioned the PHA in completing the work.

(c) If the PHA does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

34. Termination for Convenience

- (a) The Contracting Officer may terminate this contract in whole, or in part, whenever the Contracting Officer determines that such termination is in the best interest of the PHA. Any such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which the performance of the work under the contract is terminated, and the date upon which such termination becomes effective.
- (b) If the performance of the work is terminated, either in whole or in part, the PHA shall be liable to the Contractor for reasonable and proper costs resulting from such termination upon the receipt by the PHA of a properly presented claim setting out in detail: (1) the total cost of the work performed to date of termination less the total amount of contract payments made to the Contractor; (2) the cost (including reasonable profit) of settling and paying claims under subcontracts and material orders for work performed and materials and supplies delivered to the site, payment for which has not been made by the PHA to the Contractor or by the Contractor to the subcontractor or supplier; (3) the cost of preserving and protecting the work already performed until the PHA or assignee takes possession thereof or assumes responsibility therefore; (4) the actual or estimated cost of legal and accounting services reasonably necessary to prepare and present the termination claim to the PHA; and (5) an amount constituting a reasonable profit on the value of the work performed by the Contractor.
- (c) The Contracting Officer will act on the Contractor's claim within days (60 days unless otherwise indicated) of receipt of the Contractor's claim.
- (d) Any disputes with regard to this clause are expressly made subject to the provisions of the Disputes clause of this contract.

35. Assignment of Contract

The Contractor shall not assign or transfer any interest in this contract; except that claims for monies due or to become due from the PHA under the contract may be assigned to a bank, trust company, or other financial institution. Such assignments of claims shall only be made with the written concurrence of the Contracting Officer. If the Contractor is a partnership, this contract shall inure to the benefit of the surviving or remaining member(s) of such partnership as approved by the Contracting Officer.

36. Insurance

- (a) Before commencing work, the Contractor and each subcontractor shall furnish the PHA with certificates of insurance showing the following insurance is in force and will insure all operations under the Contract:
 - (1) Workers' Compensation, in accordance with state or Territorial Workers' Compensation laws.
 - (2) Commercial General Liability with a combined single limit for bodily injury and property damage of not less than \$ _____[Contracting Officer insert amount]

per occurrence to protect the Contractor and each subcontractor against claims for bodily injury or death and damage to the property of others. This shall cover the use of all equipment, hoists, and vehicles on the site(s) not covered by Automobile Liability under (3) below. If the Contractor has a "claims made" policy, then the following additional requirements apply: the policy must provide a "retroactive date" which must be on or before the execution date of the Contract; and the extended reporting period may not be less than five years

- following the completion date of the Contract.
 (3) Automobile Liability on owned and non -owned motor vehicles used on the site(s) or in connection therewith for a combined single limit for bodily injury and property damage of not less than \$ <u>1 MILLION</u>
 [Contracting Officer insert amount] per occurrence.
- (b) Before commencing work, the Contractor shall furnish the PHA with a certificate of insurance evidencing that Builder's Risk (fire and extended coverage) Insurance on all work in place and/or materials stored at the building site(s), including foundations and building equipment, is in force. The Builder's Risk Insurance shall be for the benefit of the Contractor and the PHA as their interests may appear and each shall be named in the policy or policies as an insured. The Contractor in installing equipment supplied by the PHA shall carry insurance on such equipment from the time the Contractor takes possession thereof until the Contract work is accepted by the PHA. The Builder's Risk Insurance need not be carried on excavations, piers, footings, or foundations until such time as work on the superstructure is started. It need not be carried on landscape work. Policies shall furnish coverage at all times for the full cash value of all completed construction, as well as materials in place and/or stored at the site(s), whether or not partial payment has been made by the PHA. The Contractor may terminate this insurance on buildings as of the date taken over for occupancy by the PHA. The Contractor is not required to carry Builder's Risk Insurance for modernization work which does not involve structural alterations or additions and where the PHA's existing fire and extended coverage policy can be endorsed to include such work.
- (c) All insurance shall be carried with companies which are financially responsible and admitted to do business in the State in which the project is located. If any such insurance is due to expire during the construction period, the Contractor (including subcontractors, as applicable) shall not permit the coverage to lapse and shall furnish evidence of coverage to the Contracting Officer. All certificates of insurance, as evidence of coverage, shall provide that no coverage may be canceled or nonrenewed by the insurance company until at least 30 days prior written notice has been given to the Contracting Officer.

37. Subcontracts

- (a) Definitions. As used in this contract -
 - (1) "Subcontract" means any contract, purchase order, or other purchase agreement, including modifications and change orders to the foregoing, entered into by a subcontractor to furnish supplies, materials, equipment, and services for the performance of the prime contract or a subcontract.

- (2) "Subcontractor" means any supplier, vendor, or firm that furnishes supplies, materials, equipment, or services to or for the Contractor or another subcontractor.
- (b) The Contractor shall not enter into any subcontract with any subcontractor who has been temporarily denied participation in a HUD program or who has been suspended or debarred from participating in contracting programs by any agency of the United States Government or of the state in which the work under this contract is to be performed.
- (c) The Contractor shall be as fully responsible for the acts or omissions of its subcontractors, and of persons either directly or indirectly employed by them as for the acts or omissions of persons directly employed by the Contractor.
- (d) The Contractor shall insert appropriate clauses in all subcontracts to bind subcontractors to the terms and conditions of this contract insofar as they are applicable to the work of subcontractors.
- (e) Nothing contained in this contract shall create any contractual relationship between any subcontractor and the PHA or between the subcontractor and HUD.

38. Subcontracting with Small and Minority Firms, Women's Business Enterprise, and Labor Surplus Area Firms

The Contractor shall take the following steps to ensure that, whenever possible, subcontracts are awarded to small business firms, minority firms, women's business enterprises, and labor surplus area firms:

- (a) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;
- (b) Ensuring that small and minority businesses and women's business enterprises are solicited whenever they are potential sources;
- (c) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses and women's business enterprises;
- (d) Establishing delivery schedules, where the requirements of the contract permit, which encourage participation by small and minority businesses and women's business enterprises; and
- (e) Using the services and assistance of the U.S. Small Business Administration, the Minority Business Development Agency of the U.S. Department of Commerce, and State and local governmental small business agencies.

39. Equal Employment Opportunity

During the performance of this contract, the Contractor/ Seller agrees as follows:

- (a) The Contractor/Seller shall not discriminate against any employee or applicant for employment because of of race color, religion, sex, sexual orientation, gender identity, disability, or national origin.
- (b) The Contractor/Seller shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, dischibits an external external external external.
- disability, or national origin. Such action shall
- include, but not be limited to, (1) employment, (2) upgrading demotion, (4) transfer, (5) recruitment or
 - recruitment advertising, (6) layoff or termination, (7) rates of pay or other forms of compensation, and (8) selection for training including apprenticeship

- (c) The Contractor/Seller agrees to post in conspicuous
- places available to employees and applicants for employment the notices to be provided by the Contracting Officer setting
- forth the provisions of this nondiscrimination clause.
- (d) The Contractor/Seller shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor/Seller, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
- (e) The Contractor/Seller shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(f) The Contractor/Seller shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(g) The Contractor/Seller shall furnish all information and reports required by Executive Order 11246, as amended, Section 503 of the Rehabilitation Act of 1973, as amended, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto. The Contractor/Seller shall permit

access to its books, records, and accounts by the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(h) In the event of a that the Contractor/Seller is in noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor/seller may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(i)The contractor/seller will include the provisions of paragraphs (a) through (h) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each sub[contractor/seller] or vendor. The [contractor/seller] will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions in cluding sanctions for noncompliance: Provided, however, that in the event the [contractor/seller] becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the [contractor/seller] may request the United States to enter into such litigation to protect the interests of the United States.

- (j) Compliance with the requirements of this clause shall be to the maximum extent consistent with, but not in derogation of, compliance with section 7(b) of the Indian Self-Determination and Education Assistance Act and the Indian Preference clause of this contract.
- 40. Employment, Training, and Contracting Opportunities for Low-Income Persons, Section 3 of the Housing and Urban Development Act of 1968.

- (a) The work to be performed under this contract is subject to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing.
- (b) The parties to this contract agree to comply with HUD's regulations in 24 CFR Part 135, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the Part 135 regulations.
- (c) The contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin.
- (d) The contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR Part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR Part 135. The contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR Part 135.
- (e) The contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR Part 135 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR Part 135.
- (f) Noncompliance with HUD's regulations in 24 CFR Part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.
- (g) With respect to work performed in connection with section 3 covered Indian housing assistance, section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of section 3 and section 7(b)agree to comply with section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).

41. Interest of Members of Congress

No member of or delegate to the Congress of the United States of America shall be admitted to any share or part of this contract or to any benefit that may arise therefrom.

42. Interest of Members, Officers, or Employees and Former Members, Officers, or Employees

No member, officer, or employee of the PHA, no member of the governing body of the locality in which the project is situated, no member of the governing body of the locality in which the PHA was activated, and no other public official of such locality or localities who exercises any functions or responsibilities with respect to the project, shall, during his or her tenure, or for one year thereafter, have any interest, direct or indirect, in this contract or the proceeds thereof.

43. Limitations on Payments made to Influence Certain Federal Financial Transactions

- (a) The Contractor agrees to comply with Section 1352 of Title 31, United States Code which prohibits the use of Federal appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.
- (b) The Contractor further agrees to comply with the requirement of the Act to furnish a disclosure (OMB Standard Form LLL, Disclosure of Lobbying Activities) if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

44. Royalties and Patents

The Contractor shall pay all royalties and license fees. It shall defend all suits or claims for infringement of any patent rights and shall save the PHA harmless from loss on account thereof; except that the PHA shall be responsible for all such loss when a particular design, process or the product of a particular manufacturer or manufacturers is specified and the Contractor has no reason to believe that the specified design, process, or product is an infringement. If, however, the Contractor has reason to believe that any design, process or product specified is an infringement of a patent, the Contractor shall promptly notify the Contracting Officer. Failure to give such notice shall make the Contractor responsible for resultant loss.

45. Examination and Retention of Contractor's Records

- (a) The PHA, HUD, or Comptroller General of the United States, or any of their duly authorized representatives shall, until 3 years after final payment under this contract, have access to and the right to examine any of the Contractor's directly pertinent books, documents, papers, or other records involving transactions related to this contract for the purpose of making audit, examination, excerpts, and transcriptions.
- (b) The Contractor agrees to include in first-tier subcontracts under this contract a clause substantially the same as paragraph (a) above. "Subcontract," as used in this clause, excludes purchase orders not exceeding \$10,000.
- (c) The periods of access and examination in paragraphs (a) and (b) above for records relating to (1) appeals under the Disputes clause of this contract, (2) litigation or settlement of claims arising from the performance of this contract, or (3) costs and expenses of this contract to which the PHA, HUD, or Comptroller General or any of their duly authorized representatives has taken exception shall continue until disposition of such appeals, litigation, claims, or exceptions.

46. Labor Standards - Davis-Bacon and Related Acts

If the total amount of this contract exceeds \$2,000, the Federal labor standards set forth in the clause below shall apply to the development or construction work to be performed under the contract.

(a) Minimum Wages.

(1) All laborers and mechanics employed under this contract in the development or construction of the project(s) involved will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv): also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the regular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall

be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

- (2) (i) Any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. HUD shall approve an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met: (A) The work to be performed by the classification requested is not performed by a classification in the wage determination; and (B) The classification is utilized in the area by the construction industry; and (C) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
 - (ii) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division, Employee Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary.
 - (iii) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary.
 - (iv) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (a)(2)(ii) or (iii) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in classification.
- (3) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
- (4) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the

amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

- (b) Withholding of funds. HUD or its designee shall, upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working in the construction or development of the project, all or part of the wages required by the contract, HUD or its designee may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased. HUD or its designee may, after written notice to the Contractor, disburse such amounts withheld for and on account of the Contractor or subcontractor to the respective employees to whom they are due.
- (c) Payrolls and basic records.
 - (1) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working in the construction or development of the project. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found. under 29 CFR 5.5(a)(1)(iv), that the wages of any laborer or mechanic include the amount of costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

- (2) (i) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under subparagraph (c)(1) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The Contractor is responsible for the submission of copies of payrolls by all subcontractors. (Approved by the Office of Management and Budget under OMB Control Number 1214-0149.)
 - (ii) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:
 - (A) That the payroll for the payroll period contains the information required to be maintained under paragraph (c) (1) of this clause and that such information is correct and complete;
 - (B) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3; and
 - (C) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.
 - (iii) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirements for submission of the "Statement of Compliance" required by subparagraph (c)(2)(ii) of this clause.
 - (iv) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.
- (3) The Contractor or subcontractor shall make the records required under subparagraph (c)(1) available for inspection, copying, or transcription by authorized representatives of HUD or its designee, the Contracting Officer, or the Department of Labor and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to

make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

- (d) (1) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship and Training, Employer and Labor Services (OATELS), or with a State Apprenticeship Agency recognized by OATELS, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by OATELS or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator of the Wage and Hour Division determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event OATELS, or a State Apprenticeship Agency recognized by OATELS, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.
 - (2) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under

the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- (3) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.
- (e) Compliance with Copeland Act requirements. The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.
- (f) Contract termination; debarment. A breach of this contract clause may be grounds for termination of the contract and for debarment as a Contractor and a subcontractor as provided in 29 CFR 5.12.
- (g) Compliance with Davis-Bacon and related Act requirements. All rulings and interpretations of the Davis-Bacon and related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.
- (h) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this clause shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the PHA, HUD, the U.S. Department of Labor, or the employees or their representatives.
- (i) Certification of eligibility.
 - (1) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded contracts by the United States Government by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

- (2) No part of this contract shall be subcontracted to any person or firm ineligible for award of a United States Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (3) The penalty for making false statements is prescribed in the U. S. Criminal Code, 18 U.S.C. 1001.
- (j) Contract Work Hours and Safety Standards Act. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.
 - (1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics, including watchmen and guards, shall require or permit any such laborer or mechanic in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.
 - (2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the provisions set forth in subparagraph (j)(1) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic (including watchmen and guards) employed in violation of the provisions set forth in subparagraph (j)(1) of this clause, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by provisions set forth in subparagraph (j)(1) of this clause
 - (3) Withholding for unpaid wages and liquidated damages. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the provisions set forth in subparagraph (j)(2) of this clause.
- (k) Subcontracts. The Contractor or subcontractor shall insert in any subcontracts all the provisions contained in this clause, and such other clauses as HUD or its designee may by appropriate instructions require, and also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts. The prime Contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all these provisions.

47. Non-Federal Prevailing Wage Rates

- (a) Any prevailing wage rate (including basic hourly rate and any fringe benefits), determined under State or tribal law to be prevailing, with respect to any employee in any trade or position employed under the contract, is inapplicable to the contract and shall not be enforced against the Contractor or any subcontractor, with respect to employees engaged under the contract whenever such non-Federal prevailing wage rate exceeds:
 - The applicable wage rate determined by the Secretary of Labor pursuant to the Davis-Bacon Act (40 U.S.C. 3141 et seq.) to be prevailing in the locality with respect to such trade;
- (b) An applicable apprentice wage rate based thereon specified in an apprenticeship program registered with the U.S. Department of Labor (DOL) or a DOLrecognized State Apprenticeship Agency; or
- (c) An applicable trainee wage rate based thereon specified in a DOL-certified trainee program.
- 48. Procurement of Recovered Materials.
- (a) In accordance with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, the Contractor shall procure items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR Part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition. The Contractor shall procure items designated in the EPA guidelines that contain the highest percentage of recovered materials practicable unless the Contractor determines that such items: (1) are not reasonably available in a reasonable period of time; (2) fail to meet reasonable performance standards, which shall be determined on the basis of the guidelines of the National Institute of Standards and Technology, if applicable to the item; or (3) are only available at an unreasonable price.
- (b) Paragraph (a) of this clause shall apply to items purchased under this contract where: (1) the Contractor purchases in excess of \$10,000 of the item under this contract; or (2) during the preceding Federal fiscal year, the Contractor: (i) purchased any amount of the items for use under a contract that was funded with Federal appropriations and was with a Federal agency or a State agency or agency of a political subdivision of a State; and (ii) purchased a total of in excess of \$10,000 of the item both under and outside that contract.

THE HOUSING AUTHORITY OF THE CITY OF PITTSBURGH

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

HACP Contract No. 600-19-21

WAGE DETERMINATION SCHEDULE

The construction covered by this contract is subject to the requirements of Clause 47 Labor Standards -Davis-Bacon and Related Acts of the General Conditions of the Contract for Construction. In accordance with 47 (a)(1) the wage determination of the Secretary of Labor is attached. "General Decision Number: PA20210012 01/08/2021

Superseded General Decision Number: PA20200012

State: Pennsylvania

Construction Type: Residential

County: Allegheny County in Pennsylvania.

RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.95 for calendar year 2021 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.95 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2021. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

| Modification Number | Publication Date |
|---------------------|------------------|
| 0 | 01/01/2021 |
| 1 | 01/08/2021 |

* BRPA0009-039 12/01/2020

| | Rates | Fringes |
|--|----------|---------|
| BRICKLAYER | \$ 34.50 | 23.31 |
| CARP0142-004 06/01/2018 | | |
| | Rates | Fringes |
| CARPENTER (Including Drywall Hanging and Asphalt Roofing) | \$ 28.02 | 12.59 |
| CARP1759-007 06/01/2017 | | |
| | Rates | Fringes |
| SOFT FLOOR LAYER | \$ 33.01 | 16.45 |
| * ELEC0005-013 12/26/2020 | | |

| /5/2021 | | beta.SAM.gov Search |
|--|--|--|
| | Rates | Fringes |
| ELECTRICIAN | | 16.35 |
| * ELEV0006-004 01/01/2021 | | |
| | Rates | Fringes |
| ELEVATOR MECHANIC | \$ 52.02 | 35.825+a+b |
| FOOTNOTE: | | |
| A. Employer contributes 8% of pay credit for employees with and 6% for 6 months to 5 year | more than 5 | years of service, |
| B. Eight Paid Holidays (provi consecutive days before and t holiday): New Years's Day; M Labor Day; Veteran's Day; Tha after Thanksgiving Day, and C | he working da emorial Day; nksgiving Day | y after the Independence Day; and the Friday |
| IRON0003-006 06/01/2020 | | |
| | Rates | Fringes |
| IRONWORKER, ORNAMENTAL | \$ 37.29 | 32.40 |
| PLUM0027-005 06/01/2020 | | |
| | Rates | Fringes |
| PLUMBER | \$ 43.45 | 23.47 |
| SHEE0012-006 07/01/2018 | | |
| 54220012 000 07,01,2010 | Rates | Fringes |
| Sheet metal worker | | |
| Excluding HVAC Duct Work. | \$ 19.49 | 10.08 |
| SUPA2003-001 10/31/2003 | | |
| | Rates | Fringes |
| Drywall Finishers | \$ 15.08 | 3.40 |
| Laborers, Unskilled | \$ 12.70 | 2.12 |
| PAINTER (Brush and Roller) | \$ 15.90 | 4.35 |
| PLASTERER | \$ 18.20 | 5.16 |
| Power equipment operators: (Backhoe) | \$ 17.34 | 4.06 |
| Roofer (Excluding Asphalt Roofing) | \$ 18.70 | 5.19 |
| Sheet Metal Worker (HVAC Duct Only) | \$ 16.00 | 3.08 |

WELDERS - Receive rate prescribed for craft performing

operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

> Branch of Construction Wage Determinations Wage and Hour Division U.S. Department of Labor 200 Constitution Avenue, N.W. Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator U.S. Department of Labor 200 Constitution Avenue, N.W. Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board U.S. Department of Labor 200 Constitution Avenue, N.W. Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION"

PART 4: TECHNICAL SPECIFICATIONS

Northview Heights Public Safety Center Heating and A/C Related Improvements Project AMP -09

IFB CONTRACT NO. 600-19-21

Architectural Innovations 1003 McKnight Park Drive, Pittsburgh, PA 15237 412.364.4966 Woman Business Enterprise ------_ ----------------_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Housing Authority of the City of Pittsburgh _ _ _ _ _ _ _ _ _ _ _ _ _ HVAC & AC Related Improvements Public Safety Center ------Northview Heights 441 Mount Pleasant Road _ _ _ _ _ _ _ _ _ _ _ _ _ Pittsburgh, PA 15214 -----**Project Manual** September 28, 2020 -----. ---------

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END OF SECTION 00 01 00

SECTION 00 01 15 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

A. List of Drawing Sheets: Drawings consist of the following Contract Drawings and other drawings of type indicated:

| CONTRACT |
|---|
| COVER SHEET |
| |
| CAL (HVAC) CONTRACT |
| |
| MECHANICAL DATA SHEET |
| BASEMENT FLOOR MECHANICAL DEMOLITION |
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| MECHANICAL SCHEDULES |
| |
| CAL WORK |
| |
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| FIRST FLOOR ELECTRICAL DEMOLITION PLAN |
| SECOND FLOOR ELECTRICAL DEMOLITION |
| BASEMENT FLOOR POWER PLAN |
| FIRST FLOOR POWER PLAN |
| SECOND FLOOR POWER PLAN |
| ELECTRICAL DETAILS |
| ELECTRICAL SCHEDULES |
| |

END OF SECTION

SECTION 01 10 00 - SUMMARY

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. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Contractor's use of site and premises.
 - 4. Coordination with occupants.
 - 5. Work restrictions.
- B. Related Requirements:
 - 1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Housing Authority of the City of Pittsburgh, HVAC & AC Related Improvements, Public Safety Center, Northview Heights
 - 1. Project Location: 441 Mount Pleasant Road, Pittsburgh, PA 15214
- B. Owner: Housing Authority of the City of Pittsburgh, 100 Ross Street, 2nd Floor, Suite 200, Pittsburgh, PA 15219
 - 1. Owner's Representative: To be determined.
- C. Architect: Architectural Innovations, LLC, 1003 McKnight Park Drive, Pittsburgh, PA 15237.
 1. Architect's Representative: Mr. James Johnston.
- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
 - 1. MEP: Allen & Shariff, 700 River Avenue, Suite 600, Pittsburgh, PA 15212
 - 2. Environmental: Sci Tek Consultants, Inc., 655 Rodi Road, Suite 303, Pittsburgh, PA 15235

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. HVAC and AC related improvements and investigation and testing for hazardous materials.

- B. Type of Contract:
 - 1. Project will be constructed under single prime contract

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to Work in areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

- B. On-Site Work Hours: Limit work to between 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Weekend work will be permitted if approved by Owner and authorities having jurisdiction.
 - 2. Work in Existing Building: Work in the existing building shall be permitted when it will not interfere with Owner activities.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Architect and Owner not less than three (3) days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Architect and Owner not less than three (3) days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances within the existing building and on Project site is not permitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 15 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

- 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
- 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
- 4. Include costs of labor and supervision directly attributable to the change.
- 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Owner will issue a Change Order for signatures of Owner and Contractor.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Owner may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.6 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Owner may issue a Work Change Directive. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 01 29 00 - PAYMENT PROCEDURES

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. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line-item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.

- 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
- 4. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 7th day of the month. The period covered by each Application for Payment is one month, ending on the on the 15th day of the month.
 - 1. Submit draft copy of Application for Payment seven (7) days prior to due date for review by Owner.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

- c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three (3) signed and notarized originals 1 copy of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Combined Contractor's construction schedule (preliminary if not final) incorporating
 - 5. Copies of building permits.
 - 6. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 7. Report of preconstruction conference.
 - 8. Certificates of insurance and insurance policies.
 - 9. Performance and payment bonds.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."
 - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. Evidence that claims have been settled.
 - 5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 6. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

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. 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. Project meetings.
- B. Related Requirements:
 - 1. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation.

1.3 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.
- B. Key Personnel Names: Within fifteen (15) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities, list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and in prominent location in built facility. Keep list current at all times.

1.4 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.
- C. 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, including coordination drawings.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
 - 9. Coordination and submittal of record documents.

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 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. Project name.
 - 2. Owner name.
 - 3. Owner's Project number.
 - 4. Name of Architect.

- 5. Architect's Project number.
- 6. Date.
- 7. Name of Contractor.
- 8. RFI number, numbered sequentially.
- 9. RFI subject.
- 10. Specification Section number and title and related paragraphs, as appropriate.
- 11. Drawing number and detail references, as appropriate.
- 12. Field dimensions and conditions, as appropriate.
- 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
- 14. Contractor's signature.
- 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - 1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow ten (10) 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 ten (5) days of receipt of the RFI response.

1.6 PROJECT MEETINGS

- A. General: The Architect and Owner shall schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

- 2. Agenda: The Architect shall prepare the meeting agenda. Distribute the agenda to all invited attendees.
- 3. Minutes: The Architect shall be responsible for conducting the meeting and will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including, the Owner within three (3) days of the meeting.
- B. Preconstruction Conference: The Owner shall schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than fifteen (15) days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, 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. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - 1. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Working hours.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Procedures for disruptions and shutdowns.
 - r. Construction waste management and recycling.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. First aid.
 - w. Security.
 - x. Progress cleaning.
- C. 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 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. Related RFIs.
 - c. Related Change Orders.

- d. Deliveries.
- e. Submittals.
- f. Review of mockups.
- g. Possible conflicts.
- h. Compatibility requirements.
- i. Time schedules.
- j. Weather limitations.
- k. Manufacturer's written instructions.
- l. Warranty requirements.
- m. Compatibility of materials.
- n. Acceptability of substrates.
- o. Temporary facilities and controls.
- p. Space and access limitations.
- q. Regulations of authorities having jurisdiction.
- r. Testing and inspecting requirements.
- s. Installation procedures.
- t. Coordination with other work.
- u. Required performance results.
- v. Protection of adjacent work.
- w. Protection of construction and personnel.
- 3. The Architect shall record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- 4. Reporting: The Architect shall 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.
- D. Progress Meetings: Conduct progress meetings at regular intervals as determined by Owner and Architect.
 - 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Agenda: The Architect shall 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) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.

- 10) Quality and work standards.
- 11) Status of correction of deficient items.
- 12) Field observations.
- 13) Status of RFIs.
- 14) Status of Proposal Requests.
- 15) Pending changes.
- 16) Status of Change Orders.
- 17) Pending claims and disputes.
- 18) Documentation of information for payment requests.
- c. 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.
- E. Coordination Meetings: Contractor to Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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.

1.2 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.

1.3 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, 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.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

- a. Coordination with existing construction.
- b. Limitations of continued occupancies.
- c. Uninterruptible services.
- d. Use-of-premises restrictions.
- e. Seasonal variations.
- f. Environmental control.
- B. 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.
- C. Contractor's Construction Schedule Updating: Issue schedule 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. As the Work progresses, indicate final completion percentage for each activity.
- D. Recovery Schedule: When periodic update indicates the Work is 10 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.
- E. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. 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.

1.5 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 10 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

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. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 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."

1.4 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. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Name of firm or entity that prepared submittal.
 - 5. Names of subcontractor, manufacturer, and supplier.
 - 6. Name of Contractor.
 - 7. Name of firm or entity that prepared submittal.
 - 8. Names of subcontractor, manufacturer, and supplier.
 - 9. Category and type of submittal.
 - 10. Submittal purpose and description.
 - 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 12. Drawing number and detail references, as appropriate.
 - 13. Indication of full or partial submittal.
 - 14. Location(s) where product is to be installed, as appropriate.
 - 15. Other necessary identification.
 - 16. Remarks.
 - 17. Signature of transmitter.
- B. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 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.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. 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. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.

- 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- C. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- D. 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.
- E. 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.

1.7 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 concurrently 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.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
- C. Samples: Submit Samples for review of type, 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. Disposition: Maintain sets of approved Samples at Project site, available for qualitycontrol 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.
- 5. 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 one Sample set; 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:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
- E. 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.
- F. 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 AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- G. 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.

1.8 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 and three paper copies 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.

1.9 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.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Reviewed, Approved, or Accepted: Where submittals are marked 'Reviewed', 'Approved', or 'Accepted', that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
 - 2. Furnish as Corrected, Approved as Noted, or Accepted as Noted: Where submittals are marked 'Furnish as Corrected', 'Approved as Noted', or 'Accepted as Noted', that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents.
 - 3. Revise and Resubmit: When submittals are marked 'Revise and Resubmit', do not proceed with that part of the Work covered by the submittal. Revise or prepare a new submittal in accordance with notations and resubmit without delay.
 - 4. Rejected or Not Approved: When submittals are marked 'Rejected' or 'Not Approved', pursue actions so the submittal complies with Contract Document requirements and resubmit for review and approval.

- 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 return without review 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

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

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. 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.

1.3 USE CHARGES

- A. Sewer Service: Include the cost for portable chemical toilet(s) at Project site in the Mechanical Construction Contract.
- B. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.
- C. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Waste-handling procedures.

- D. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
 - 1. Methods used to meet the goals and requirements of the Owner.
 - 2. Concrete cutting method(s) to be used.
 - 3. Location of construction devices on the site.
 - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

PART 2 - PRODUCTS

- A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

A. 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.

3.2 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
- 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. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."

3.3 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.
- 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.
 - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. 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.
- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover

END OF SECTION

SECTION 01 73 00 - EXECUTION

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. 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.

1.3 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.

1.4 QUALITY ASSURANCE

- A. 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.
- B. 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.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
- B. 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.

C. 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 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.
- 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.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.4 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. 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.
- 5. 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.

3.5 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 (27 deg C).

- 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 50 00 "Temporary Facilities and Controls."
- 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.

3.6 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 PROTECTION AND REPAIR 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. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. 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.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

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. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 - 6. Advise Owner of changeover in utility services.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements.

- 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
 - 1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
 - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:

- 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
- 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
- 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. 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 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
- i. Vacuum concrete.
- j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- 1. Remove labels that are not permanent.
- m. Wipe surfaces of mechanical and electrical equipment and similar equipment.
- n. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

SECTION 017839 - 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.
- B. Related 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.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

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. Details not on the original Contract Drawings.
- 1. Field records for variable and concealed conditions.
- m. 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. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 - 1. Format: Annotated PDF electronic file.
 - 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 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.
 - e. Name of Owner.
 - f. 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.
- B. Format: Submit record specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.5 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 Owner's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 10 22 13 – EXPANDED METAL MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diamond raised mesh security cage.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-place Concrete"

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For units with factory-applied color finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Basis of Design:</u> SpaceGuard Products, which is located at: 711 S. Commerce Dr.; Seymour, IN 47274;Toll Free Tel: 800-841-0680; Tel: 812-523-3044; Email: sales@spaceguardproducts.com Web: <u>www.BeastWireMesh.com</u>
- B. Available Manufacturers/Products: 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. Niles Metal Products.
 - 2. The G-S Company.

2.2 MATERIALS

- A. Steel Mesh: ³/₄" #9, carbon steel standard raised profile.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

- C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- D. Steel Pipe: ASTM A53/A53M, Schedule 40, unless another weight is indicated or required by structural loads.
- E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513, Type 5, mandrel-drawn mechanical tubing.

2.3 STANDARD-DUTY EXPANDED METAL MESH PARTITIONS

- A. Mesh: Steel Mesh ³/₄" #9, carbon steel expanded metal mesh.
- B. Vertical Panel Framing: 1-1/4 inch by 1-1/4 inch by 1/8 inch hot rolled angle, notched at both ends, with 1-1/4 inches by 7/16-inch slotted holes punched approximately 6-inches O.C. from one end, then every 12 inches O.C. from the first hole. Vertical frames can range from 6-inch length up to 60 inches.
- C. Horizontal Panel Framing: 1-1/4 inch by 1-1/4 inch by 1/8 inch hot rolled angle, with 1-1/4 inches by 7/16-inch slotted holes punched approximately 6-inches O.C. from one end, then every 12-inches O.C. from the first hole. Horizontal frames can range from 6-inch length up to 120 inches.
- D. Horizontal Panel Stiffeners: 1/4-inch by 3/4-inch thick hot rolled flat stock, center located and welded to wire mesh and horizontal frames on panels greater than 60 inches in length.
- E. Panels: Consisting of the above horizontal and vertical members welded at all corners, with mesh securely welded to frame. Stiffener bars, when required, shall be added at the engineered locations. Standard panels range in 1-foot increments from 1-foot by 1-foot up to 5-feet by 10-feet.
- F. Posts for 90-Degree Corners: 2-inch by 2-inch by 14 gauge (.0747-inch) square tube with a series of 7/16-inch diameter holes drilled on all four sides to accept hardware to connect panels and doors. Standard posts, ranging from 7-foot, 2-inch to 12-foot, 2-inch in 1-foot increments, are drilled with the first hole 8-inch from the bottom and spaced every 12-inch on center leaving a 2-inch maintenance sweep space below panels and doors. Standard floor connections are made by 2-inch by 7-inch by 1/4-inch steel flat base plate welded to base of post and punched to accept two 3/8-inch diameter anchors.
- G. Posts for Other-Than-90-Degree Corners: Steel pipe or tubing with holes for 1/4-inch- (6-mm-) diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.
 - 1. Partitions up to 12 Feet (3.7 m) High: 1-1/4-inch (32-mm) OD by 1/8 inch (3.2 mm).
 - 2. Partitions up to 20 Feet (6.1 m) High: 2-1/2-inch (65-mm) OD by 1/8 inch (3.2 mm).
- H. Base Plates: Standard floor connections are made by 2-inch by 7-inch by 1/4-inch steel flat base plate welded to base of post and punched to accept two 3/8-inch diameter anchors.
- I. Swinging Bi-Part Doors: Fabricated of the same materials as panels with a standard 86-inch clearheight opening. Complete with all necessary mounting and locking hardware to install and operate. Standard door includes a 3-sided lock plate welded to accommodate Cylinder Lock or Padlock Arrangement. Single doors are 3-foot and double (bi-parting) doors are a pair of single doors.
 - 1. Hinges: Full-surface type, 3-by-3-inch (76-by-76-mm) steel, three per door; bolted, riveted, or welded to door and jamb framing.
 - 2. Padlock Lug: Mortised into door framing and enclosed with steel cover.

- 3. Cylinder Lock: Mortise type with manufacturer's standard cylinder; operated by key outside and recessed turn knob inside.
- J. Finish: Powder-coated finish unless otherwise indicated.
 - 1. Color: Battleship Gray

2.4 EXPANDED METAL MESH CEILING

- A. Mesh, Framing, and Stiffeners: Fabricated from same mesh and framing as expanded metal mesh partition panels.
- B. Perimeter Partition Supports: 1-1/2-by-1-1/2-by-0.075-inch (38-by-38-by-1.9-mm) steel angle, with holes for 1/4-inch- (6-mm-) diameter bolts aligned for bolting to top of wire mesh partitions and to sides of wire mesh ceiling panels.

2.5 FABRICATION

- A. General: Fabricate expanded metal mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
 - 1. Fabricate expanded metal mesh items to be readily disassembled.
 - 2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.
- B. Standard-Duty Expanded Metal Mesh Partitions: Fabricate expanded metal mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
 - 1. Mesh: Weld mesh to framing.
 - 2. Framing:
 - a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
 - 3. Fabricate expanded metal mesh partitions with 2 to 3 inches (75 to 100 mm) of clear space between finished floor and bottom horizontal framing.
 - 4. Doors: Align bottom of door with bottom of adjacent panels.
 - a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
 - 5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.
- C. Expanded Metal Mesh Ceilings: Fabricate expanded metal mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

- 1. Mesh: Weld mesh to framing.
- 2. Framing:
 - a. Provide stiffeners as indicated or, if not indicated, as required by panel span and as recommended by wire mesh ceiling manufacturer. Weld stiffeners to framing.

2.6 STEEL AND IRON FINISHES

- A. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Color and Gloss: Battleship Gray.

PART 3 - EXECUTION

3.1 EXPANDED METAL MESH PARTITIONS ERECTION

- A. Anchor mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter post-installed expansion anchors at 12 inches (300 mm) o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
- B. Secure ceiling panels to the side framing channels with factory supplied hardware.
- C. Provide line posts at locations indicated.
- D. Where standard-width expanded metal mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
- E. Install doors complete with door hardware.

3.2 WIRE MESH CEILINGS ERECTION

- A. Attach wire mesh ceiling panels to wall support angles with bolts at 12 inches (305 mm) o.c.
- B. Attach wire mesh ceiling panels to wire mesh partitions with slotted angles bolted to sides of ceiling panels and to top of partitions at 12 inches (305 mm) o.c.
- C. Attach wire mesh ceiling panels to intermediate supports as recommended by manufacturer.

3.3 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION

SECTION 230010 – MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. These basic Mechanical Requirements are specifically applicable to all Mechanical Division Sections, in addition to Division 01 - General Requirements, the General Conditions and the Supplementary General Conditions which also apply to this division.
- B. This Section includes instructions on general project objectives, alternates, allowances, asbuilt drawings, submittals, regulatory requirements, demolition instructions, and installation instructions.
- C. Mechanical systems include all HVAC & mechanical work.

1.02 SCOPE OF WORK:

- A. Low and high velocity ductwork.
- B. Hot water piping.
- C. Refrigerant piping and condensate drain piping.
- D. Motor Starters and Disconnects
- E. Variable Frequency Drives
- F. Control Wiring
- G. Power wiring to controls
- H. Temperature controls, electronic.
- I. Demolition of existing equipment and systems.

1.03 DEFINITIONS

- A. Any reference in this Division to "this Contractor", "Contractor" or reference to furnish or install or to supply any work with no reference to the Contractor responsible shall be furnished and installed under this division.
- B. "Provide "- Furnish and install.
- C. "Furnish" Obtain and deliver to the job for installation by other trades.
- D. "Install" Set and connect an equipment item furnished by others. Place item in full operating condition.
- E. Mechanical and HVAC words are used inter-change ably and have the same meaning.

1.04 SITE VISIT

A. The Trades estimating this work shall visit the site before submitting bids and fully inform themselves of the nature of the work and of the existing conditions, obtain all necessary

MECHANICAL GENERAL REQUIREMENTS 23 00 10 - 1 information to estimate and execute the work. Failure to do so shall in no way obligate the Owner for any omissions or errors resulting from such negligence.

B. Any costs involved in relocating any items, including those of other trades, in order to install the work shown shall be included in the bid price.

1.05 INTENT OF DRAWINGS

- A. Separate drawings have been prepared for the convenience of the General, Plumbing, Heating and Electrical Trades. Their work is generally shown under the proper heading however; all drawings listed are part of each contract insofar as they are applicable. Particularly as they apply to space limitations, obstructions, type of construction, and space requirements for the installation of other trades work.
- B. The drawings are diagrammatic and additional transitions, offsets, fittings, drains, vents and drips shall be provided as may be required to install the systems, even if not shown, at no additional cost.
- C. The drawings take precedence over the specifications where there is conflicting information or whichever is more stringent.
- D. The systems shall be complete, ready for operation with all components required, including items which may not be fully shown or specified. Items not shown, fully detailed or specified, but required for a complete system shall be provided at no extra cost and shall conform to accepted trade practices. Connect every terminal unit, air outlet/inlet and equipment item.

1.06 AS-BUILT DRAWINGS

A. During construction, the Contractor shall maintain a separate reproducible set of Mechanical drawings on which he shall record the exact location of all concealed piping and ductwork which is not installed as shown. These "as built" drawings shall be delivered to the Architect at the end of the job.

1.07 SUBMITTALS AND SUBSTITUTIONS

- A. Submit under provisions of the General Requirements all products in this division. Submit shop drawings and product data only if manufacturers or products supplied deviate from the specification requirements, space indicated or capacities scheduled. Shop drawings submitted because of deviations shall be submitted as instructed in this section and in the further instructions given in the individual sections. Products fully complying with these specifications do not have to be submitted.
- B. Submit Substitutions under provisions of the General Requirements and Conditions and the instructions given in this section of the specifications.
- C. Basis of Design: Where drawings and specifications call for materials of certain manufacturers, the contract shall be based on materials specified. If the Contractor wishes to offer substitutions for consideration he must request approval 10 days prior to bid opening. Any substitutions made after the bid is received will not be accepted.
- D. Full Drawings: Submit field checked and coordinated equipment room piping and ductwork layouts at 3/8" equals 1'0" and ductwork layouts of the floor plans at 1/4" equals 1'0" scale.

- E. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal. Highlight equipment data. General Catalog data will be returned unless custom highlighted.
- F. Mark dimensions and values in units to match those specified. List any differences between the product submitted and the product specified and shown on the drawings.
- G. All materials and equipment shall be new and shall of good quality and equal in all respects to the products of well recognized and reputable United States' manufacturers.
- H. Where the specifications give more than one manufacturer's name for an item of equipment, the drawings are based on the name given first. Additional names indicate only that these manufacturers make equipment of acceptable quality and before using same, it shall be the responsibility of the Contractor to determine if the dimensions, mechanical and electrical characteristics are suitable. If revisions in the work or of other trades are required due to use of any equipment other than shown on the drawings, the additional cost shall be included in the Bid Price.
- I. Within 15 days after the award of a contract, the Contractor shall submit a complete list of materials and sub-contractors he proposes to use for approval.
- J. Manufacturer's installation diagrams shall be provided for all equipment requiring shop drawings. Shop drawings shall be submitted in a timely manner for examination and comment.
- K. Approval shall be considered as general only and as aid to the Contractor. Any items missed in review and/or are counter to the drawings do not relieve the Contractor from the necessity of furnishing the materials and performing all work as required by the plans and specifications. Review of shop drawing does not constitute the engineer takes responsibly the shop drawings are correct or complete and is only a convenience to the contractor to correct any errors made by the contractor or vendor.

1.08 REGULATORY REQUIREMENTS

A. Conform to the following codes:

- 1. International Mechanical Code/2015 Edition.
- 2. International Energy Code/2015Edition
- 3. International Building Code/2015 Edition.
- 4. International Plumbing Code/2015 Edition
- 5. ASHRAE 90.1 2010 Energy Standard for Buildings Except Low-Rise Residential Buildings
- 6. Building Code amendments as adopted by the Commonwealth of Pennsylvania.
- 7. Building Code amendments as adopted by the local jurisdiction.
- B. Nothing in the Contract Documents shall be construed to conflict with any laws, ordinances or regulations of authorities having jurisdiction over the contract work and all requirements shall be complied with throughout, without additional cost to the Owner.
- C. Obtain permits, pay any fees and request inspections from authority having jurisdiction.
- D. All mechanical equipment shall bear the label of an approved agency.

1.09 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other sections. Obtain permission of Architect/Engineer before proceeding.
- C. The Contractor is solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours. The duty of the Engineer to visit the site is not intended to include review of the adequacy of the Contractor's safety in, on, or near the construction site.

1.10 CHASES, CUTTING AND PATCHING

- A. This trade shall cooperate with the General trade, advising him of the sizes, number and locations of all openings, recesses, access doors and panels, and pipe sleeves required to properly install his pipe lines, ducts etc. Unless otherwise shown or noted all piping, ducts etc., in finished rooms shall be completely concealed in partitions or furred spaces. The Mechanical trade shall install all required sleeves which shall be built into place as the general construction proceeds.
- B. Cutting where necessary for Mechanical work shall be done by the Mechanical Trade in a neat and careful manner to prevent damage or weakening of walls, roof or floors and shall meet the approval of the Architect/Engineer. Patching caused by the Mechanical Trade shall be done by the Mechanical Trade for holes up to 12"x 12" (one square foot). Patching material shall match adjacent surfaces. Larger holes shall be cut and patched by the General Trade at the expense of the Mechanical Trade.

1.11 SALVAGE AND SCRAP

A. This Contractor shall carefully dismantle all equipment and materials shown or specified to be removed. That which is not indicated or specified to be reused shall remain the property of the Owner and be placed in storage where directed on the premises. Unwanted materials shall become the property of the Contractor and shall be removed.

1.12 ASBESTOS REMOVAL

A. The removal of asbestos materials, if required, shall be done under another contract. No known asbestos present at the site shall require removal due to installation of the work for this Project.

PART 2 - PRODUCTS

2.01 FIRE BARRIER MATERIALS

A. Approved fill material for fire barriers shall be packed mineral wool, T & B Flame-Safe, 3M Fire Barrier caulk or Dow Corning RTV foam. Approved protective devices shall be UL listed fire dampers for ductwork and UL listed "link-seals" for piping. Large shaft and wall openings around ducts and piping and shaft floors where fire ratings must be maintained shall be infilled with 3M Inc. fire barrier wall sheets.

2.02 ACCESS DOORS

- A. Manufacturers:
- B. Milcor Inc. or approved equal as determined by the designer.
- C. Access doors shall be of metal with mounting frame and screw driver operated CAM lock latches flush with panel face. Provide 2 hour fire rated and 3 hour fire rated doors where required for shaft walls and fire rated floors and ceilings. See architectural drawings for locations of fire rated walls. Doors shall have continuous hinges.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with the instructions in these specifications and as shown on the drawings. In lieu of a where a specific item is not detailed, install in accordance with industry standards.
- B. All equipment shall be installed in accordance with the instructions which shall be available at the job site. If the installation instructions are contrary to the work shown or specified, the contractor shall consult the engineer before proceeding with the installation.

3.02 PROCEDURE AND COORDINATION

- A. Pipe lines, conduits, etc., other than Mechanical contract work shall be under installation throughout the building site and this Contractor shall consult with all other trades to coordinate the assembly and installation of all trades to avoid conflict and need for rearrangement, as no extras shall be granted due to lack of coordination. This applies particularly to locations of ducts, heating and plumbing pipes, electric conduits, recessed lights fixtures, etc., which occur in close quarters such as furred walls, columns & ceilings, pipe and duct shafts etc., and where minimum head clearances shall be maintained.
- B. Do not install piping or ductwork in transformer rooms, electric equipment rooms, electric closets or generator rooms unless they serve these spaces. Do not install piping adjacent to electric devices. Provide drip pan protection if piping must be installed above or adjacent to electric panels or devices.
- C. Mechanical equipment shall be installed in a manner to permit ease of service and the Mechanical Contractor shall inform other trades of access requirement to prevent interference with same.
- D. All new piping, ductwork, equipment, etc. shall be installed so that it does not interfere with access to existing valves, access doors, equipment, etc.
- E. Protect all unfinished work from damage. Seal off all portions of the duct systems or piping not being worked on to permit continued service and to prevent the entry of dirt. Install temporary filters over all exhaust/return air openings in the work area. Repair or replace any damage caused by the installation of the Mechanical systems.
- F. Where alterations of new work affect the use of present buildings or facilities, the Contractor shall schedule his work and activities so that interference is kept to a minimum. When

shutdown of existing systems or equipment is required, the work shall be executed at the convenience of the Owner under the direction of the Architect/Engineer.

3.03 PROTECTION OF BUILDING FIRE/SMOKE BARRIERS

- A. Passages of pipes and air ducts through fire barriers and/or smoke barriers shall be protected as follows:
 - 1. The space between the penetrating item and the fire barrier and/or smoke barrier shall be filled with a material capable of maintaining the fire/smoke resistance of the barrier or be protected by an approved device design for the specific purpose.
- B. Where the penetrating item uses a sleeve to penetrate the fire and/or smoke barrier the sleeve shall be solidly set in the fire/smoke barrier and the space between the item and the sleeve shall be filled as described below.
 - 1. All piping or duct insulation shall stop at each side of a fire barrier and the void space between the item and the rated barrier shall be protected. Void space between fire barriers and piping and ductwork subject to surface condensation shall be filled with caulk or foam material capable of preventing vapor transmission. Sufficient room shall be maintained for expansion.
- C. Fire barriers shall include 1-hour, 2-hour, 3-hour and 4-hour UL rated floors and walls. Refer to architectural plans for location of fire barriers and smoke barriers and provide protection required to maintain ratings in accordance with all codes the applicable codes.
- D. Approved fill material for fire barriers shall be packed mineral wool, T & B Flame-Safe, 3M Fire Barrier caulk or Dow Corning RTV foam. Approved protective devices shall be UL listed fire dampers for ductwork and UL listed "link-seals" for piping. Large shaft and wall openings around ducts and piping and shaft floors where fire ratings must be maintained shall be infilled with 3M Inc. fire barrier wall sheets.

3.04 ACCESS DOORS

A. Install access doors where required to service equipment or to reach devices for adjustment concealed behind walls, ceilings, or floors. Accessible ceilings do not require access doors. Minimum size 12x6".

3.05 PAINTING

A. In finished spaces, painting of all Mechanical equipment, apparatus and piping shall be done by the Painting Trade under the General Trade Specification, except where specified to be done by the Mechanical Trade.

3.06 TEMPORARY HEAT

- A. The costs of temporary heat, including utility costs, shall be at the expense of the Heating Trade. The Heating Trade shall provide the means of temporary heat. Existing heating equipment and systems may be used and such use shall be coordinated between the Heating Trade and General Trade.
- B. The permanent Mechanical system shall not be used under any exceptions to provide

HVAC & AC RELATED IMPROVEMENTS HACP PUBLIC SAFETY CENTER NORTHVIEW HEIGHTS MECHANICAL GENERAL REQUIREMENTS 23 00 10 - 6 temporary heating, ventilating, exhaust or air condition until the building is clean, without any dust or debris that can enter the Mechanical system and is ready for occupancy. Covering the return/exhaust air inlets with filter media is not acceptable alternative to having an enclosed, dust-free environment for the systems to operate in. In no event shall the Heating Contractor's one year warranty be shortened by the use of permanent equipment for temporary heat.

3.07 ELECTRICAL REQUIREMENTS

- A. Furnish to the electrical trade for installation all disconnect switches, combination motor starters, variable frequency drives and electrical devices for all Mechanical equipment. Refer to Section 230510 Mechanical Electrical Devices and Requirements.
- B. Electrical trade will provide power wiring to Mechanical equipment.
- C. Mechanical Trade shall provide power wiring to Mechanical control devices.
- D. Mechanical Trade shall provide control wiring to Mechanical systems.
- E. Mechanical Trade shall furnish to electrical trade disconnect means for all Mechanical devices.

3.08 INTERFERENCE DRAWINGS

- A. The contractor shall arrange with his subcontractors to prepare "Interference Drawings" immediately after the award of the contract. This shall be accomplished as set forth below.
- B. The Mechanical Subcontractor shall initiate the drawings by preparing plans and sections by either hand drawing or in electronic CADD format at a scale of 1/4" to 1'-0" for the floor plans and at 3/8" to 1'-0" for the Mechanical Room plans, or larger if desired, on which he shall show all ducts, fans, air handling units, coils, filters, dampers, grilles, louvers, registers, piping, appliances, and equipment. The drawings shall clearly show the structural conditions into which his work will be incorporated. The Mechanical shop drawings and shop sheets of approved items shall be used in the preparation of the interference drawings. All items shall be drawing to scale in an accurate manner. If required, he shall consult with the Mechanical consulting engineer. At the completion of the drawings, he shall furnish re-producible sepia or in suitable electronic CADD format drawings and forward them to the Plumbing Subcontractor.
- C. The Plumbing Subcontractor shall then add all plumbing piping and equipment to the drawings, using the sizes of the approved items, and depicting them accurately. The plumbing items shall be positioned to avoid interference with the Mechanical work, and the Plumbing Subcontractor shall consult with the Mechanical Contractor as required if interferences arise. All unresolved locations shall be discussed with the Plumbing consulting engineer. After the drawings have been completed to the satisfaction of both the Mechanical and Plumbing Subcontractors, the Plumbing Contractor shall furnish new reproducible sepia or electronic medium drawings and forward them to the Electrical Subcontractor.
- D. The Electrical Subcontractor shall add his work to the drawings, showing conduit runs; pull boxes, panel boards, and all other equipment. Where interferences arise, he shall resolve them through discussions with the Mechanical Subcontractors, or with the electrical consulting engineer. After the installations are shown to the satisfaction of the Mechanical

and Electrical Subcontractors, the Electrical Subcontractor shall forward new reproducible sepia or electronic medium drawings to the Architect.

- E. The General Contractor shall advise his subcontractors for mechanical and electric work of the grid pattern for acoustical ceilings, the depth of acoustical and plastered ceiling systems, locations of hangers, and all else whatsoever which will affect the mechanical and electrical installations.
- F. The Architect and the consulting engineers will review the drawings, and after corrections and/or approval, shall return them to the General Contractor, who shall have the drawings printed for his own use and for distribution to his subcontractors. Two prints are required for each subcontractor, and four for the Architect.
- G. The preparation of the drawings shall take place immediately following the award of the contract. All installation work shall be performed in the accordance with the interference drawings.

3.09 CLEANUP

A. All tools, benches and other workmen's materials and appliances shall be removed from the premises after formal and final approval of completion is given. The premises shall be cleaned of all remaining debris. During start-up of duct cleaning of air systems, protect all occupied areas from dirt from protective filters over air outlets and where needed, air tight covers over computers and other sensitive equipment. Clean lose dust from the area.

3.10 INSTRUCTIONS and OPERATION AND MAINTENANCE MANUALS

A. See section 01700.

- B. Upon final acceptance and turning over of the project to the Owner, make available qualified persons fully familiar with the installation and capable of instructing the Owner's staff in the operation, care and manipulation of the various systems.
- C. Engage a factory-authorized service representative to train]Owner's maintenance personnel to adjust, operate, and maintain units.
- D. Provide to owner three copies of; final submittals, all shop drawings, equipment and ductwork layouts, valve tagging charts, testing and balancing data, operation and maintenance data on equipment furnished, list of suppliers and service organizations for each piece of equipment, spare parts list, warranty information, as-built drawings and all other information requested in Execution section of the mechanical sections of these specifications. Assemble into loose leaf binders indexed by tabs per each item with table of contents.

3.11 MECHANICAL WARRANTY

- A. Refer to Division 01 for general warranty requirements. Review all Division 23 sections for additional installation and equipment warranties.
- B. The mechanical contractor shall guarantee that all apparatus is of best grade and quality and that all work has been done in strict accord with the specifications and drawings. Correct defects in workmanship, materials and equipment that develop within one year from date of acceptance by repair or replacement.

C. Provide an additional one year of warranty beyond the first year's warranty for the control system to include (2) two additional visits in the second year, one during the heating season and on during the cooling season. During these visits check the systems for proper operation and make adjustments necessary, including software re-programming, to ensure the control system operates as intended.

END OF SECTION 23 00 10

SECTION 23 01 30.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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 cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
- C. Cleaning Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air.
 - 2. Air-terminal units.
 - 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.

- b. Return-air ducts to the air-handling unit.
- c. Exhaust-air ducts.
- 4. Air-Handling Units:
 - a. Interior surfaces of the unit casing.
 - b. Coil surfaces compartment.
 - c. Condensate drain pans.
 - d. Fans, fan blades, and fan housings.
- 5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using sourceremoval mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
 - 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
 - c. Fibrous materials that become wet shall be discarded and replaced.
- N. Coil Cleaning:
 - 1. Measure static-pressure differential across each coil.
 - 2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
 - 3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
 - 4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
 - 5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
 - 6. Rinse thoroughly with clean water to remove any latent residues.
- O. Antimicrobial Agents and Coatings:
 - 1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.

- 2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
- 3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
- 4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
 - 1. Perform surface comparison testing or NADCA vacuum test.
 - 2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Verification of Coil Cleaning:
 - 1. Measure static-pressure differential across each coil.
 - 2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of factory set static pressure, the differential measured when the coil was first installed.
 - 3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- F. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.
- G. Photographic Documentation: Provide photographs of cleaning procedures, before and after photos, and cleaning methods while conducting the duct cleaning procedure. Provide photographs to owner after completion of cleaning.

3.5 **RESTORATION**

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts".
- D. Replace damaged insulation according to Section 230713 "Duct Insulation."
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION 23 01 30.51

SECTION 23 05 13 - COMMON MOTOR AND ELEC. REQUIREMENTS FOR HVAC EQUIP.

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Provide shaft protection brushes to prevent eddy currents from VFD drive.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ACCEPTABLE MANUFACTURERS - MOTOR STARTERS, DISCONNECTS

- 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. Square D; www.squared.com.
 - B. Eaton Electrical/Cutler-Hammer; www.eatonelectrical.com.
 - C. GE Industrial; www.geindustrial.com.
 - D. Substitutions: See Section 01600 Product Requirements.

2.7 MANUAL MOTOR STARTERS

- A. Manual Motor Starter: NEMA ICS 2; size M-0 2 pole, AC general-purpose Class A manually operated, non-reversing, full-voltage controller for induction motors rated in horsepower, with overload relay, low voltage protection, red, neon or LED pilot light to indicate motor is energized, and toggle operator. Provide the number of contacts required to satisfy the sequence of described control in Section 230993.
- B. Enclosure: ANSI/NEMA ICS 6; Type 1.

2.8 MANUAL START SWITCHES

- A. Manual Start Switches: Toggle type snap switch, thermal overload device operating on the solder-ratchet principal, manual reset, red, neon or LED pilot light to indicate motor is energized, rated for 1 HP maximum at 115/230 volts AC.
- B. Enclosure: NEMA 1, general purpose, suitable for flush mounting in standard 2-5/8" deep wall switch box, brushed stainless steel cover plate.

2.9 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle with defeatable interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1; Type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle with defeatable interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1; Type 1. or as indicated on Drawings.

PART 3 - EXECUTION

3.1 ELECTRICAL MOTOR STARTER, AND DISCONNECT SWITCH INSTALLATION AND SELECTION

- A. Furnish disconnect switches to electrical trade to be installed by them.
- B. Furnish disconnect means for all HVAC devices either integral to the equipment or via a separate disconnect switch. Furnish fused disconnect switches with fuses where required by the equipment manufacturer.
- C. Furnish fuses to electrical trade for installation in fusible disconnect switches.
- D. Furnish manual motor starters, combination motor starters and/or variable frequency drives for all HVAC equipment to the electrical trade for installation.
- E. All three phase starters shall be combination type and have control power transformers.
- F. Furnish all items of electrical apparatus shown and described on the drawings. Those items which are indicated to be installed by the Electrical Contractor shall be properly tagged and delivered to him at the job site. All shall be of same brand.
- G. Inform electrical trade to install motor control equipment and/or variable frequency drives in accordance with manufacturer's instructions.
- H. Select and install heater elements in motor starters to match installed motor characteristics and furnish to electrical trade for installation.
- I. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

- J. Motors indicated as being provided with the equipment shall be furnished installed in the equipment by the equipment manufacturer.
- K. All power wiring will be provided by the Electrical trade. All control wiring and power wiring to the controls will be provided by the Temperature Control Sub-Contractor.
- L. All motors 30 horsepower and larger shall have reduced voltage starters.
- M. The EQUIPMENT SCHEDULES TAKE PRECEDENCE over any wiring diagrams and motor control center schedules. The horsepower s and loads listed in the equipment schedules shall be used to select the motor starters, disconnects switches and the motor control centers.

3.2 ELECTRICAL REQUIREMENTS DIVISION OF WORK

- A. Furnish to the electrical trade for installation all disconnect switches, conbination motor starters, variable frequency drives adn electrical devices for all HVAC equipment.
- B. Electrical trade will provide power wiring to HVAC equipment.
- C. HVAC Trade shall provide power wiring to HVAC control devices.
- D. HVAC Trade shall provide control wiring to HVAC system.
- E. HVAC Trade shall provide power/control wring to damper and valve actuators. (This is not shown on the drawings.)
- F. HVAC Trade shall furnish to Electrical Trade disconnect means for all HVAC equipment.

END OF SECTION 23 05 13

SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC 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.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber 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.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Presealed Systems.
- B. 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. In fire rated assembly infill opening between sleeve and pipe with fire proofing material.
- C. 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.
- 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 AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 Insert pipe size and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 23 05 17

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Fastener systems.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Metal pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Fastener systems.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

- 1. Properties: Nonstaining, noncorrosive, and nongaseous.
- 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- C. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- J. Insulated Piping:
 - 1. Attach clamps and spacers to piping.

- a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 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 welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 230010
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

- 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
- 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
- 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
- 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
- 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow offcenter closure for hanger installation before pipe erection.
- 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
- 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
- 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
- 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steelpipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- 15. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
- 16. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 17. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 18. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 5. C-Clamps (MSS Type 23): For structural shapes.
 - 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
 - 8. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 9. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 11. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 12. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

- 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
- 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS 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. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Open-spring isolators.
 - 5. Housed-spring isolators.
 - 6. Restrained-spring isolators.
 - 7. Housed-restrained-spring isolators.
 - 8. Pipe-riser resilient supports.
 - 9. Resilient pipe guides.
 - 10. Air-spring isolators.
 - 11. Restrained-air-spring isolators.
 - 12. Elastomeric hangers.
 - 13. Spring hangers.
 - 14. Snubbers.
 - 15. Restraint channel bracings.
 - 16. Restraint cables.
 - 17. Seismic-restraint accessories.
 - 18. Mechanical anchor bolts.
 - 19. Adhesive anchor bolts.
 - 20. Vibration isolation equipment bases.
 - 21. Restrained isolation roof-curb rails.
- B. Related Requirements:
 - 1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
 - 2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by **an agency acceptable to authorities having jurisdiction**.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
 - 1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic **and wind** forces required to select vibration isolators and seismic **and wind** restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

- 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
- 4. Seismic **and Wind**-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic[and wind] restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By **an agency acceptable to authorities having jurisdiction**, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For **professional engineer and testing agency**.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For **air-spring mounts** to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: 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 and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 4. Size: Factory or field cut to match requirements of supported equipment.
 - 5. Pad Material: Oil and water resistant with elastomeric properties.
 - 6. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
 - 7. Infused nonwoven cotton or synthetic fibers.
 - 8. Load-bearing metal plates adhered to pads.
 - 9. Sandwich-Core Material: [Resilient] [and] [elastomeric] <Insert compound>.
 - a. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 3. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
 - 4. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 **RESTRAINED ELASTOMERIC ISOLATION MOUNTS**

- A. Restrained Elastomeric Isolation Mounts:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings**or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.

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- 3. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 **OPEN-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 7. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
 - 8. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

- a. Ace Mountings Co., Inc.
- b. California Dynamics Corporation.
- c. Isolation Technology, Inc.
- d. Kinetics Noise Control, Inc.
- e. Mason Industries, Inc.
- f. Vibration Eliminator Co., Inc.
- g. Vibration Isolation.
- h. Vibration Mountings & Controls, Inc.
- 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 7. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top housing with [attachment and leveling bolt] [threaded mounting holes and internal leveling device] [elastomeric pad].

2.6 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig (3.45 MPa)on isolation material providing equal isolation in all directions.

2.7 **RESILIENT PIPE GUIDES**

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.8 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows:

- 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:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings**or comparable product by one of the following:
 - a. Firestone Industrial Products Company.
 - b. Mason Industries, Inc.
- 3. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
- 4. Maximum Natural Frequency: 3 Hz.
- 5. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
- 6. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
- 7. Tank valves.

2.9 **RESTRAINED-AIR-SPRING ISOLATORS**

- A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] or comparable product by one of the following:
 - a. Firestone Industrial Products Company.
 - b. Mason Industries, Inc.
 - 3. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top plate with [threaded mounting holes] [elastomeric pad].
 - c. Internal leveling bolt that acts as blocking during installation.
 - 4. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 - 5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 9. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
 - 10. Maximum Natural Frequency: 3 Hz.

- 11. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
- 12. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
- 13. Tank valves.

2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Mountings & Controls, Inc.
 - 3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 4. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 - 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:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.

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- g. Vibration Mountings & Controls, Inc.
- 3. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
- 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- 9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- 10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.12 **RESTRAINT CHANNEL BRACINGS**

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut.
- C. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.13 **RESTRAINT CABLES**

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - 1. Kinetics Noise Control, Inc.

- 2. Loos & Co., Inc.
- 3. Vibration Mountings & Controls, Inc.
- C. Restraint Cables: **ASTM A 492 stainless**-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.14 MECHANICAL ANCHOR BOLTS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- C. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.15 ADHESIVE ANCHOR BOLTS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- C. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.16 VIBRATION ISOLATION EQUIPMENT BASES

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - 1. California Dynamics Corporation.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries, Inc.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- C. Steel Rails: Factory-fabricated, welded, structural-steel rails.
 - Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

mmi)Include supports for suction and discharge elbows for pumps.

- 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
- 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
 - Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- E. Concrete Inertia Base: [Factory-fabricated] [or] [field-fabricated], welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

- a. Include supports for suction and discharge elbows for pumps.
- 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
- 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by **an agency acceptable to authorities having jurisdiction**.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 Cast-in-Place Concrete.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Equipment Restraints:

- 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
- 3. Install seismic-restraint devices using methods approved by **an agency acceptable to authorities having jurisdiction** that provides required submittals for component.
- D. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of [40 feet (12 m)] o.c., and longitudinal supports a maximum of [80 feet (24 m)] o.c.
 - 3. Brace a change of direction longer than 12 feet (3.7 m).
- E. Install cables so they do not bend across edges of adjacent equipment or building structure.
- F. Install seismic-restraint devices using methods approved by **agency acceptable to authorities having jurisdiction** that provides required submittals for component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- J. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least **four** of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 AIR-SPRING ISOLATOR INSTALLATION

A. Independent Isolator Installation:

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- 1. Install tank valve into each air isolator.
- 2. Inflate each isolator to [height] [and] [pressure] specified on Drawings.
- B. Pressure-Regulated Isolator Installation:
 - 1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
 - 2. Connect all pressure regulators to a single dry, filtered [facility] [constant] air supply.
 - 3. Inflate isolators to [height] [and] [or] [pressure] specified on Drawings.

3.8 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053, "Miscellaneous Cast-in-Place Concrete."]

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Pipe labels.
 - 3. Duct labels.
 - 4. Valve tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: Yellow.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover **[cover full**] circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 incheshigh.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping per ANSI standards.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Heating Water Piping:
 - a. Background Color: Orange.
 - b. Letter Color: White.
 - 2. Refrigerant Piping:
 - a. Background Color: Light Blue.
 - b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Refrigerant: 1-1/2 inches, square.
 - b. Hot Water: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Refrigerant: Natural.
 - b. Hot Water: Natural.
 - 3. Letter Color:
 - a. Refrigerant: White.
 - b. Hot Water: White.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING 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. Section Includes:
 - Balancing Air Systems:

 a. Variable-air-volume systems.
 b. .
 - Balancing Hydronic Piping Systems:
 a. Variable-flow hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with **Commissioning Authority** on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by **Commissioning Authority**.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan curves.

- 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.

- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 - 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 - 3. Set terminal units at full-airflow condition.
 - 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Adjust terminal units for minimum airflow.
 - 6. Measure static pressure at the sensor.
 - 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.

- 2. Check liquid level in expansion tank.
- 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
- 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
- 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
- 6. Set system controls so automatic valves are wide open to heat exchangers.
- 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
- 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.8 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

- 1. Entering- and leaving-water temperature.
- 2. Water flow rate.
- 3. Water pressure drop.
- 4. Dry-bulb temperature of entering and leaving air.
- 5. Wet-bulb temperature of entering and leaving air for cooling coils.
- 6. Airflow.
- 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Airflow.
 - 3. Air pressure drop.
 - 4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.12 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.13 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.

- g. Settings for supply-air, static-pressure controller.
- h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.
- E. Apparatus-Coil Test Reports:
 - 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft..
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - 1. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- H. Air-Terminal-Device Reports:
 - 1. Unit Data:

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- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft..
- 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- I. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- J. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

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3.15 INSPECTIONS

- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 - 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect **Commissioning Authority**.
 - 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of **Commissioning Authority**.
 - 3. **Commissioning Authority**shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 - 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT 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 duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
- B. Related Sections:
 - 1. Section 233113 "Metal Ducts" for duct liners.

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. 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sheet Form Insulation Materials: 12 inches square.
 - 2. Sheet Jacket Materials: 12 inches square.
 - 3. 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.

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 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork 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 heat tracing.

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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.2 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges Marathon Industries; 501.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
- d. Mon-Eco Industries, Inc.; 55-10.
- 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
- 3. Service Temperature Range: 0 to 180 deg F.
- 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
- 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- DI. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.4 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
- 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
- 4. Service Temperature Range: 0 to plus 180 deg F.
- 5. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. Mon-Eco Industries, Inc.; 44-05.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 TAPES

- A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

- A. Bands:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
 - 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.

- 3) Midwest Fasteners, Inc.; CD.
- 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
- 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inchdiameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inchdiameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

2.8 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

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.

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 ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.

- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 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 duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

- 1. Comply with requirements in Section 078413 "Penetration Firestopping"irestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitordischarge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
- b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
- 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitordischarge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.

- b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

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; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 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: Two 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.

3.10 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 ductwork, 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 one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 - 7. Indoor, concealed oven and warewash exhaust.
 - 8. Indoor, exposed oven and warewash exhaust.
 - 9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 11. Outdoor, concealed supply and return.
 - 12. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. See schedule on the drawings.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. See schedule on the drawings.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. See schedule on the drawings.

END OF SECTION 23 07 13

SECTION 23 08 00 - COMMISSIONING OF HVAC

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. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.

- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Contractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R systems, subsystems, and equipment Testing Procedures

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located

and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

- 2. Description of equipment for flushing operations.
- 3. Minimum flushing water velocity.
- 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. The Work of this Section shall not be measured separately for payment.

4.2 PAYMENT

A. No separate payment will be made for the Work of this Section.

END OF SECTION 23 08 00

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL 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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Section 230519 "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
 - 2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.

- 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
- 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
- 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
- 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
- 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
- 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
- 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - 1. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION

1.6 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.

- 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- 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. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 - 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Samples for Initial Selection: For each color required, of each type of thermostat[or sensor] cover with factory-applied color finishes.
- D. Samples for Verification: For each color required, of each type of thermostat[or sensor] cover.

1.7 INFORMATIONAL SUBMITTALS

- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- B. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.

- C. Qualification Data: For [Installer] [and] [manufacturer].
- D. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- E. Field quality-control test reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5. Calibration records and list of set points.
- B. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- 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. Replacement Materials: One replacement diaphragm or relay mechanism for each unique [pneumatic damper motor] [valve motor] [controller] [thermostat] [positioning relay].
 - 2. Maintenance Materials: **[One]** <**Insert number required**> thermostat adjusting key(s).
 - 3. Maintenance Materials: One pneumatic thermostat test kit.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

- B. 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.
- C. Comply with ASHRAE 135 for DDC system components.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.12 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Section 281600 "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- C. Coordinate equipment with Section 281300 "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate equipment with Section 275313 "Clock Systems" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Section 284619 "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate equipment with Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System" to achieve compatibility with equipment that interfaces with that system.
- H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- I. Coordinate equipment with Section 260913 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- J. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.

- K. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

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 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Alerton Inc.
 - 2. American Auto-Matrix.
 - 3. Andover Controls Corporation.
 - 4. Automated Logic Corporation.
 - 5. Carel.
 - 6. Delta Controls Inc.
 - 7. EDA Controls Corp.
 - 8. Electronic Systems USA, Inc.
 - 9. Functional Devices Inc.
 - 10. Heat-Timer Corporation.
 - 11. Honeywell International Inc.; Home & Building Control.
 - 12. Impact Energy Controls Corp.
 - 13. Invensys Building Systems.
 - 14. Johnson Controls, Inc.; Controls Group.
 - 15. KMC Controls/Kreuter Manufacturing Company.
 - 16. Luwa USA, Inc.; Textile Air Engineering.
 - 17. MAMAC Systems, Inc.
 - 18. McQuay International.
 - 19. Pneuline Controls.
 - 20. Sauter Controls Corporation.
 - 21. Siemens Building Technologies, Inc.
 - 22. Solidyne Corp.

- 23. Spence Engineering Company, Inc.
- 24. Staefa Control System Inc.; Siemens Building Technologies, Inc.
- 25. TAC Americas, INC.
- 26. TCS/Basys Controls.
- 27. tekmar Control Systems, Inc.
- 28. Teletrol Systems Incorporated.
- 29. Temco Controls Ltd. USA.
- 30. Tour & Andersson Control, Inc.
- 31. Trane; Worldwide Applied Systems Group
- 32. Triangle MicroSystems, Inc.
- 33. Voltec, Inc.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and **72** hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. **Perform scheduling with real-time clock.** Perform automatic system diagnostics; monitor system and report failures.
 - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 - 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
 - 5. Enclosure: Waterproof rated for operation at 40 to 150 deg F.

2.4 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch-thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and

HVAC & AC RELATED IMPROVEMENTS HACP PUBLIC SAFETY CENTER NORTHVIEW HEIGHTS keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.

- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
 - 1. Alarm Condition: Indicating light flashes and horn sounds.
 - 2. Acknowledge Switch: Horn is silent and indicating light is steady.
 - 3. Second Alarm: Horn sounds and indicating light is steady.
 - 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
 - 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.5 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.
- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
 - 1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
 - 2. Proportional band shall extend from 2 to 20 percent for 5 psig.
 - 3. Authority shall be 20 to 200 percent.
 - 4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
 - 5. Gages: [1-1/2 inches] [2-1/2 inches] [3-1/2 inches] in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.6 TIME CLOCKS

- A. Manufacturers:
 - 1. ATC-Diversified Electronics.
 - 2. Grasslin Controls Corporation.
 - 3. Paragon Electric Co., Inc.
 - 4. Precision Multiple Controls, Inc.
 - 5. SSAC Inc.; ABB USA.
 - 6. TCS/Basys Controls.
 - 7. Theben AG Lumilite Control Technology, Inc.
 - 8. Time Mark Corporation.
- B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.
- C. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.7 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. Ebtron, Inc.
 - c. Heat-Timer Corporation.
 - d. I.T.M. Instruments Inc.
 - e. MAMAC Systems, Inc.
 - f. RDF Corporation.
 - 2. Accuracy: Plus or minus **0.5 deg F** at calibration point.
 - 3. Wire: Twisted, shielded-pair cable.
 - 4. Insertion Elements in Ducts: Single point, **8 inches** long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - 5. Averaging Elements in Ducts:**36 inches long, flexible**use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
 - 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.

- 7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Exposed.
 - c. Thermometer: **Exposed**
 - d. Color: Select from manufacturer's full range.
 - e. Orientation: Vertical or Horizontal.
- 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- 9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 1. Set-Point Adjustment: Exposed.
 - 2. Set-Point Indication: Exposed.
 - 3. Color: Select from manufacturer's full range of colors.
 - 4. Orientation: Vertical or Horizontal.
- D. Room sensor accessories include the following:
 - 1. Insulating Bases: For sensors located on exterior walls.
 - 2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base
 - 3. Adjusting Key: As required for calibration and cover screws.

2.8 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or splitcore transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
 - 1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. I.T.M. Instruments Inc.

2.9 FLOW MEASURING STATIONS

- A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
 - 1. Manufacturers:
 - a. Air Monitor Corporation.
 - b. Wetmaster Co., Ltd.
 - 2. Casing: Galvanized-steel frame.
 - 3. Flow Straightener: Aluminum honeycomb, 3/4-inch parallel cell, 3 inches deep.
 - 4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.10 THERMOSTATS

- A. Manufacturers:
 - 1. Erie Controls.
 - 2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
 - 3. Heat-Timer Corporation.
 - 4. Sauter Controls Corporation.
 - 5. tekmar Control Systems, Inc.
 - 6. Theben AG Lumilite Control Technology, Inc.
- B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
 - 1. Label switches "FAN HIGH-LOW-OFF"
 - 2. Mount on single electric switch box.
- C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.

- 2. Preferential rate control to minimize overshoot and deviation from set point.
- 3. Set up for four separate temperatures per day.
- 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
- 5. Short-cycle protection.
- 6. Programming based on every day of week.
- 7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
- 8. Battery replacement without program loss.
- 9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- G. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:

- 1. Reset: Manual.
- 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or **automatic** reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 - 1. Bulb Length: Minimum 20 feet.
 - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or **automatic** reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
 - 1. Bulb Length: Minimum 20 feet.
 - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.11 HUMIDISTATS

- A. [Available]Manufacturers:
 - 1. MAMAC Systems, Inc.
 - 2. ROTRONIC Instrument Corp.
 - 3.
- B. Pneumatic Room Humidistats: Wall-mounting, proportioning type with adjustable throttling range, **20 to 90** percent operating range, and cover matching room thermostat cover.
- C. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.
- D. Pneumatic Duct-Mounting Humidistats: Proportioning type with adjustable throttling range, 20 to 90 percent operating range, in galvanized-steel duct box.

2.12 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - b.
 - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 - 4. Coupling: V-bolt and V-shaped, toothed cradle.
 - 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 - 7. Power Requirements (Two-Position Spring Return): [24] [120] [230]-V ac.
 - 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 - 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

- 10. Temperature Rating: Minus 22 to plus 122 deg F
- 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

2.13 DAMPERS

- A. Manufacturers:
 - 1. Air Balance Inc.
 - 2. Don Park Inc.; Autodamp Div.
 - 3. TAMCO (T. A. Morrison & Co. Inc.).
 - 4. United Enertech Corp.
 - 5. Vent Products Company, Inc.
- B. Dampers: AMCA-rated, **opposed**-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with **oil-impregnated sintered bronze** or **nylon** blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.14 AIR SUPPLY

- A. Manufacturers:
 - 1. Drainview Products.
 - 2. Pneuline Controls.
- B. Control and Instrumentation Tubing: Copper tubing complying with ASTM B 88, Type K or ASTM B 280 Type ACR.
 - 1. Fittings: Cast-bronze solder fittings complying with ASME B16.18; or wrought-copper solder fittings complying with ASME B16.22, except forged-brass compression-type fittings at connections to equipment.
 - 2. Joining Method: Soldered or brazed.
- C. Control and Instrumentation Tubing: ASTM D 2737 Type FR plenum-rated polyethylene, flame-retardant, nonmetallic tubing rated for 30 psig and ambient temperature range of 10 to 150 deg F with flame-retardant harness for multiple tubing.

- 1. Fittings: Compression or push-on polyethylene fittings.
- D. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.
- E. Duplex Air Compressor: Capacity to supply compressed air to temperature-control system.
 - 1. Pressure control with adjustable electric contacts, set to start and stop both compressors at different pressures.
 - 2. Electrical alternation set with motor starters and disconnect to operate compressors alternately or on time schedule.
- F. Simplex Air Compressor: Tank-mounting compressor with capacity to supply compressed air to temperature-control system, with starter and disconnect.
 - 1. Pressure control with adjustable electric contacts, set to start and stop compressor.
- G. Compressor Type: Scroll.
- H. Size compressor and tank to operate compressor not more than **30** minutes during a 60-minute period.
- I. Compressor Accessories: Low-resistance intake-air filter, and belt guards.
- J. System Accessories: Air filter rated for 97 percent efficiency at rated airflow, and combination filter/pressure-reducing station or separate filter and pressure-reducing station.
- K. Refrigerated Air Dryer: Self-contained, refrigerated air dryer complete with heat exchangers, moisture separator, internal wiring and piping, and with manual bypass valve.
 - 1. Heat Exchangers: Air-to-refrigerant coils with centrifugal-type moisture separator and automatic trap assembly.
 - 2. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 13 deg F at 20 psig, housed in steel cabinet with access door and panel.
 - 3. Accessories: Air-inlet temperature gage, air-inlet pressure gage, on-off switch, hightemperature light, power-on light, refrigerant gage on back, air-outlet temperature gage, air-outlet pressure gage, and with contacts for remote indication of power status and hightemperature alarm.
- L. Desiccant Dryer: Obtains dew point in pneumatic air piping between compressor and tank at least 15 deg F below inlet-air dew point at design conditions.
- M. Pressure Gages: Black letters on white background, 2-1/2 inches in diameter, flush or surface mounting, with front calibration screw to match sensor, and having a graduated scale in psig.
- N. Instrument Pressure Gages: Black letters on white background, 1-1/2 inches in diameter, stem mounted, with suitable dial range.

- O. Diaphragm Control and Instrument Valves: 1/4-inch forged-brass body with reinforced polytetrafluoroethylene diaphragm, stainless-steel spring, and color-coded phenolic handle.
- P. Gage Cocks: Tee or level handle, bronze, rated for 125 psig.
- Q. Relays: For summing, reversing, and amplifying highest or lowest pressure selection; with adjustable I/O ratio.
- R. Switches: With indicating plates and accessible adjustment; calibrated and marked.
- S. Pressure Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat reduced-pressure curve.
- T. Particle Filters: Zinc or aluminum castings with 97 percent filtration efficiency at rated airflow, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.
- U. Combination Filter/Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat reduced-pressure curve; with threaded pipe connections, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.
- V. Airborne Oil Filter: Filtration efficiency of 99.9 percent for airborne lubricating oil particles of 0.025 micron or larger.
- W. Pressure Relief Valves: ASME rated and labeled.
 - 1. High Pressure: Size for installed capacity.
 - 2. Low Pressure: Size for installed capacity of pressure regulators and set at 20 percent above low pressure.
- X. Pressure-Reducing Stations: Two parallel pressure regulators.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Mount compressor and tank unit on spring isolators with 1-inch static deflection. Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.
 - 1. Pipe manual and automatic drains to nearest floor drain.
 - 2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices **48 inches** above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- F. Install automatic dampers according to Section 233300 "Air Duct Accessories."
- G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- I. Install hydronic instrument wells, valves, and other accessories according to Section 232116 Hydronic Piping Specialties."
- J. Install steam and condensate instrument wells, valves, and other accessories according toSection 232216 Steam and Condensate Piping Specialties."
- K. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."
- L. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."

M. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. 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 unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

- 4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
- 5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
- 6. Test calibration of **electronic** controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- 7. Test each point through its full operating range to verify that safety and operating control set points are as required.
- 8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
- 9. Test each system for compliance with sequence of operation.
- 10. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and selfcontained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 - 11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:
 - 1. Calibrate instruments.
 - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

- 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
- 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
- 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
- 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
- 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
- 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
- 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
- 10. Provide diagnostic and test instruments for calibration and adjustment of system.
- 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 09 00

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410a:
 - 1. Suction Lines for Air-Conditioning Applications: 650 psig.
 - 2. Suction Lines for Heat-Pump Applications: 650 psig.
 - 3. Hot-Gas and Liquid Lines: 800 psig.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- 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. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 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.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- 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 misalignment in minimum 7-inchlong assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 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.
- 7. Maximum Operating Temperature: 275 deg F.
- 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.
 - 8. Maximum Operating Temperature: 275 deg F.
- 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.
 - 8. Working Pressure Rating: 500 psig.
 - 9. Maximum Operating Temperature: 275 deg F.
- 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.
- 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 conduit adapter, and 24-V ac coil.
 - 6. Working Pressure Rating: 400 psig.
 - 7. Maximum Operating Temperature: 240 deg F.
 - 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.
- 6. Maximum Operating Temperature: 240 deg F.
- 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.
 - 6. Superheat: Nonadjustable.
 - 7. Reverse-flow option (for heat-pump applications).
 - 8. End Connections: Socket, flare, or threaded union.
 - 9. Working Pressure Rating: 700 psig.
- H. 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.
 - 5. Maximum Operating Temperature: 275 deg F.
- I. 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.
 - 6. Maximum Operating Temperature: 275 deg F.
- J. 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.
 - 7. Maximum Operating Temperature: 240 deg F.
- K. 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.
- 4. Designed for reverse flow (for heat-pump applications).
- 5. End Connections: Socket.
- 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
- 7. Maximum Pressure Loss: 2 psig.
- 8. Rated Flow: Per Contract Drawings
- 9. Working Pressure Rating: 650 psig.
- 10. Maximum Operating Temperature: 240 deg F.
- L. 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.
 - 4. Designed for reverse flow (for heat-pump applications).
 - 5. End Connections: Socket.
 - 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 - 7. Maximum Pressure Loss: 2 psig.
 - 8. Rated Flow: Per contract drawings
 - 9. Working Pressure Rating: 650 psig.
 - 10. Maximum Operating Temperature: 240 deg F.
- M. 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.
 - 4. Maximum Operating Temperature: 275 deg F.

2.3 **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.
- C. ASHRAE 34, R-410a

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15 and manufacturer guidelines.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping adjacent to machines to allow service and maintenance.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- J. Install refrigerant piping in protective conduit where installed belowground.
- K. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- L. 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.

- M. 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.
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- O. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 PIPE JOINT CONSTRUCTION

- A. 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.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "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 long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet 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: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.

- 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
- 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
- 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

3.5 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 and specialties. 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.

3.6 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. 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.
 - 4. Charge system with a new filter-dryer core in charging line.

3.7 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.

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- 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 23 23 00

SECTION 23 31 13 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
 - 2. Double-wall rectangular ducts and fittings.
 - 3. Single-wall round ducts and fittings.
 - 4. Double-wall round and flat-oval ducts and fittings.
 - 5. Sheet metal materials.
 - 6. Duct liner.
 - 7. Sealants and gaskets.
 - 8. Hangers and supports.
 - 9. Seismic-restraint devices.
- B. Related Sections:
 - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 - 3. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 - 4. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, ductmounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct

Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

- 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
- 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
- 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. Design Calculations: Calculations for selecting hangers and supports and seismic restraints.

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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- 1. Duct constructed using prefabricated systems will refer to the manufacturer's guidelines for sheet gauge, intermediate reinforcement size and spacing, and proper joint reinforcement(s).
- 2. Manufacturers of prefabricated systems must have duct construction and reinforcement guidelines along with supporting independent leakage and deflection performance testing. Manufacturer's prefabricated systems printed assembly and installation procedures must be adhered to during all phases.
- 3. All components of prefabricated system must be clearly embossed with manufacturer's markings and systems manufacturer clearly identified on all duct labels. No substitution of system components is permitted.
 - 4. Approved Manufacturer: Ductmate Industries or Ward Duct Connectors Incorporated "W.D.C.I."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>McGill AirFlow LLC</u>.

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2. <u>Sheet Metal Connectors, Inc.</u>

- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Lindab Inc</u>.
 - b. <u>McGill AirFlow LLC</u>.
 - c. <u>SEMCO Incorporated</u>.
 - d. <u>Sheet Metal Connectors, Inc</u>.
 - e. <u>Spiral Manufacturing Co., Inc.</u>
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 50 Inches in Diameter: Flanged.
 - a. Unexposed Duct 3 inchto 30 inch Diameter: Round duct connects with a one-piece interior slip coupling at least two gages heavier than duct wall, beaded at center and fastened to duct with screws. Seal joint with an approved sealant applied continuously around both ends of coupler prior to assembling and after fastening.
 - b. All Exposed Duct and Unexposed Duct 30 inch to 72 inch Diameter: Three-piece, gasket flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure band, which compress the gasket between the internal flanges.
 - c. Duct above 72 inch diameter: Use companion angle flanged joints as defined in Figure 3-1 fo the 2005 SMACNA Manual "HVAC Duct Construction Standards, Metal and Flexible" Third Edition. Refer to manual for proper sizing and construction details.
 - d. Dust Collection Systems and Exposed Duct 3 inch to 14 inch: Use a one-piece, polyethylene lined gasket connector with integrated bolt for the closure system.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with buttwelded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Lindab Inc</u>.
 - 2. <u>McGill AirFlow LLC</u>.
 - 3. <u>SEMCO Incorporated</u>.
 - 4. <u>Sheet Metal Connectors, Inc.</u>
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 50 Inches in Diameter: Flanged.
 - 1) All Exposed Duct and Unexposed Duct 30 inch to 72 inch Diameter: Threepiece, gasket flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure band, which compress the gasket between the internal flanges.
 - 2) Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Spiralmate or comparable product by one of the following:
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

- b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at75 deg F mean temperature.

2.5 SELF-SEALING SINGLE-WALL ROUND DUCT AND FITTINGS FOR LOW PRESSURE DUCT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Greenseam+ and Greenseam Sealed Fittings or comparable product.
- B. Duct Construction Pressure 2 inches wg:
 - 1. Round Low Velocity Ductwork:
 - a. Constructed from a minimum of 26 gauge, self-locking, factory sealed snaplock pipe, which incorporates a factory-applied gasket in the longitudinal seam and on the female end of the transverse joint.
 - 2. Fittings:
 - a. All high efficiency take-offs, conicals, ad collars must have a factory applied gasket along all rivets, co-latches, and flange.
 - b. All fittings shall be constructed from a minimum of 26 gauge steel.
 - c. All dampered fittings must have low-leakage hardware with closed-end bearings.

2.6 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
 - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: Black.
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- I. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.7 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>CertainTeed Corporation; Insulation Group</u>.
 - b. Johns Manville.
 - c. <u>Knauf Insulation</u>.
 - d. <u>Owens Corning</u>.
- B. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Aeroflex USA Inc</u>.

- b. <u>Armacell LLC</u>.
- c. <u>Rubatex International, LLC</u>
- 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Bonded Logic, Inc</u>.
 - b. <u>Reflectix Inc</u>.
 - 2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at75 deg F mean temperature when tested according to ASTM C 518.
 - 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
 - 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Polyester Duct Liner: Duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing. Liner must have a noise reduction coefficient of at least 0.65 and have thermal values greater or equal to an R-5 at 1 ¹/₄", R-6 at 1¹/₂" and R-8 at 2" respectively.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide [product indicated on Drawings]
 - a. Ductmate Industries, PolyArmor
 - 2. Polyester liner must be able to withstand a constant internal temperature up to 250°F (121°C,) must be compliant with Greenguard Environmental Institute, and contain zero

VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C518, ASTM G-21, NFPA 90A and 90B, and UL 181.

- 3. Polyester duct liner must be attached using a non flammable, low VOC water based adhesive. When applicable, apply a non flammable, low VOC water based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions. Liner must consist of at least 25% recycled content.
- 4. Polyester duct liner must be installed per section 7.4 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," Third Edition unless otherwise specified.
- F. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- G. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure buttededge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 - 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 - 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

- a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Proseal or comparable product by one of the following:
 - a. Hardcast.
 - b. Polymer Adhesives
 - 2. Application Method: Brush on.
 - 3. Solids Content: Minimum 65 percent.
 - 4. Shore A Hardness: Minimum 20.
 - 5. Water resistant.
 - 6. Mold and mildew resistant.
 - 7. VOC: Maximum 75 g/L (less water).

- 8. Flexibility: Flexible after curing.
- 9. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- 10. UL 181 B-M listed; UL 723 Classified.
- 11. Service: Indoor or outdoor.
- 12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Ic.; Solvseal or comparable product by one of the following:
 - a. Hardcast.
 - b. Polymer Adhesives.
 - 2. Application Method: Brush on.
 - 3. Base: Synthetic rubber resin.
 - 4. Solvent: Toluene and heptane.
 - 5. Solids Content: Minimum 60 percent.
 - 6. Shore A Hardness: Minimum 60.
 - 7. Water resistant.
 - 8. Mold and mildew resistant.
 - 9. Flexibility: Flexible after curing.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. VOC: Maximum 395 g/L.
 - 12. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 13. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - 14. Service: Indoor or outdoor.
 - 15. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- F. Flange Gaskets: Butyl rubber. gaskets complying with UL 723 and meeting Mil-C 18969B and TTS-S-001657. Material shall not contain vegetable oils, fish oils, or any other type vehicle that will support fugal and/or bacterial growth.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate industries, Inc.; Ductmate 440 Butyl Gasket or comparable productg:
- G. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.10 SEISMIC-RESTRAINT DEVICES

A. <u>Manufacturers</u>: 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. <u>Cooper B-Line, Inc.; a division of Cooper Industries.</u>
- 2. <u>Hilti Corp</u>.
- 3. <u>Kinetics Noise Control</u>.
- 4. Loos & Co.; Cableware Division.
- 5. <u>Mason Industries</u>.
- 6. <u>TOLCO; a brand of NIBCO INC</u>.
- 7. <u>Unistrut Corporation; Tyco International, Ltd.</u>
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.

- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 SUPPLY, OUTSIDE AIR AND RETURN DUCTWORK LOCATED OUTDOORS

A. Fabricate ducts with ALUMINUM with three sides. Locate longitudinal seams on bottom. Use flanged joints sealed weather and water tight. Cross breaks top to shed water. Internally insulate with non-fibrous duct insulation with coating to resist high air velocities.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.

- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.8 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.9 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:

- a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
- b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- 4. Test for leaks before applying external insulation.
- 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
- 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch

insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.

- 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
- 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.
 - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.12 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.13 DUCT SCHEDULE

- A. See schedule on the drawings.
- B. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
- C. Supply, return, transfer and outside air Ducts: See schedule on drawings for construction and pressure class ratings.
- D. Kitchen Exhaust Ductwork
 - 1. Kitchen exhaust ductwork shall be sized to have a minimum velocity of 1500 FPM with the same net area from the duct collar to the exhaust fan.
 - 2. It shall be constructed of 16 gauge metal of either black iron steel, properly primed and painted with suitable high temperature paint, or galvanized steel with welded seams which are primed and painted.
 - 3. Ductwork shall be welded, liquid tight (continuous external welds) to comply with NFPA 96.
 - 4. Furnish airtight cleanouts as required by code, as indicated on the drawings, and at each change in direction.
 - 5. Ductwork shall be sloped to pitch a minimum of ¹/₄" per lineal foot.

E. Listed Grease Ducts

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Heat-Fab, Inc.
 - b. Metal-Fab, Inc.
 - c. Schebler Co. (The).
 - d. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - e. Van-Packer Company, Inc.
- 2. Description: Double-wall metal vents tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.

- 3. Construction: Inner shell and outer jacket separated by at least a 1- inch annular `space filled with high- temperature, ceramic-fiber insulation.
- 4. Inner Shell: ASTM A 666, Type 304 stainless steel.
- 5. Outer Jacket: Aluminized steel where concealed. Stainless steel where exposed.
- 6. Accessories: Tees, elbows, increasers, hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters and drain fittings.
- F. Dishwasher Exhaust Ductwork
 - 1. Dishwasher exhaust ductwork shall be 16 gauge, type 304 stainless steel, liquid-tight, continuous welded construction.
- G. FUME EXHAUST DUCTWORK (Corrosive Atmosphere)
 - 1. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards or High Pressure Duct Construction Standards depending on the duct velocities and pressure duty.
 - 2. Construct of 304 stainless steel with stainless steel "Ductmate" or "WARD Connector" mechanical flanges using neoprene gaskets.

OR

3. Construct of 316 stainless steel with all welded joint construction.

OR

- 4. Construct of 304 stainless steel using standard SMACNA joints and seams suitable for the class of constructions. Seal all joints water and air tight with clear silicone sealer
- H. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 4. Aluminum Ducts: or galvanized sheet steel coated with zinc chromate.
- I. Liner: (Where indicated on plans.)
 - 1. Supply Air Ducts: Poly Natural fiber, 1.5 inch thick.
 - 2. Return Air Ducts: Fibrous glass, Type I or Natural fiber, 1 inch thick.
 - 3. Exhaust Air Ducts: Fibrous glass, Type I or Natural fiber, 1 inch thick.
 - 4. Supply Fan Plenums: Flexible elastomeric or Natural fiber, 1.5 inch thick.
 - 5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches thick.
 - 6. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
 - 7. Located outdoors: 2 inch thick Natural or poly fiber
- J. Double-Wall Duct Interstitial Insulation:
 - 1. Supply Air Ducts: 1.5 inch thick.
 - 2. Return Air Ducts: 1 inch thick.
 - 3. Exhaust Air Ducts: 1 inch thick.
- K. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:

- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- L. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

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. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Control dampers.
 - 5. Fire dampers.
 - 6. Ceiling radiation dampers.
 - 7. Smoke dampers.
 - 8. Combination fire and smoke dampers.
 - 9. Corridor dampers.
 - 10. Flange connectors.
 - 11. Duct silencers.
 - 12. Turning vanes.
 - 13. Remote damper operators.
 - 14. Duct-mounted access doors.
 - 15. Flexible connectors.
 - 16. Flexible ducts.
 - 17. Duct security bars.
 - 18. Duct accessory hardware.
- B. Related Requirements:
 - 1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
 - 2. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
 - 3. Section 283112 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and brushed finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Pottorff.
 - 7. Ruskin Company.

- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
 - 1. Material: Nonferrous metal.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Bird.
 - 9. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Air Balance Inc.; a division of Mestek, Inc.
- 2. American Warming and Ventilating; a division of Mestek, Inc.
- 3. Cesco Products; a division of Mestek, Inc.
- 4. Greenheck Fan Corporation.
- 5. Nailor Industries Inc.
- 6. Pottorff.
- 7. Ruskin Company.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners or mechanically attached.
- F. Blades:
 - 1. Multiple, 0.025-inch-thick, roll-formed aluminum.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- G. Blade Seals: Vinyl.
- H. Blade Axles: Nonferrous metal.
- I. Tie Bars and Brackets:
 - 1. Material: Aluminum.
 - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Synthetic.
- L. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Pottorff.
 - g. Ruskin Company.
 - h. Trox USA Inc.
- 2. Standard leakage rating.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Trox USA Inc.

- 2. Standard leakage rating.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
- 6. Blade Axles: Nonferrous metal.
- 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Aluminum.
- C. Low-Leakage, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 - 2. Comply with AMCA 500-D testing for damper rating.
 - 3. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 4. Suitable for horizontal or vertical applications.
 - 5. Frames:
 - a. Hat shaped.
 - b. 0.094-inch-thick, galvanized sheet steel.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 6. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.

- c. Stiffen damper blades for stability.
- d. Galvanized, roll-formed steel, 0.064 inch thick.
- 7. Blade Axles: [Galvanized steel].
- 8. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 9. Blade Seals: Vinyl.
- 10. Jamb Seals: Cambered stainless steel.
- 11. Tie Bars and Brackets: Galvanized steel.
- 12. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 - 2. Comply with AMCA 500-D testing for damper rating.
 - 3. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 4. Suitable for horizontal or vertical applications.
 - 5. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 6. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
 - 7. Blade Axles: Nonferrous metal.
 - 8. Bearings:
 - a. Molded synthetic.

- b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 9. Blade Seals: Vinyl.
- 10. Jamb Seals: Cambered stainless steel.
- 11. Tie Bars and Brackets: Aluminum.
- 12. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- E. Jackshaft:
 - 1. Size: 0.5-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- F. Damper Hardware:
 - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Arrow United Industries; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. McGill AirFlow LLC.
 - 6. Nailor Industries Inc.
 - 7. Pottorff.
 - 8. Ruskin Company.
 - 9. Young Regulator Company.
- B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 - 1. Hat shaped.
 - 2. 0.094-inch-thick, galvanized sheet steel.

- 3. Mitered and welded corners.
- D. Blades:
 - 1. Multiple blade with maximum blade width of 6 inches.
 - 2. Parallel- and opposed-blade design.
 - 3. Galvanized-steel.
 - 4. 0.064 inch thick single skin or 0.0747-inch-thick dual skin.
 - 5. Blade Edging: Closed-cell neoprene.
 - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 - 1. Molded synthetic.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.7 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Arrow United Industries; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Pottorff.
 - 7. Prefco; Perfect Air Control, Inc.
 - 8. Ruskin Company.
 - 9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.05 or 0.39 inch thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch-0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 212 deg F Insert temperature rated, fusible links.
- K. Heat-Responsive Device: Electric, resettable link and switch package, factory installed, 165 deg F and 212 deg F rated.

2.8 CEILING RADIATION DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Prefco; Perfect Air Control, Inc.
 - 6. Ruskin Company.
 - 7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 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 hours.

2.9 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Pottorff.
 - 6. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.
- I. Damper Motors: Modulating or two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC 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.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

- 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
- 7. Electrical Connection: 115 V, single phase, 60 Hz.
- K. Accessories:
 - 1. Auxiliary switches for signaling or position indication.
 - 2. Test and reset switches, remote mounted.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Pottorff.
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
- F. Heat-Responsive Device: Resettable, 212 deg F rated, fire-closure device.
- G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- H. Smoke Detector: Integral, factory wired for single-point connection.
- I. Blades: Roll-formed, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.
- J. Leakage: Class I.
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: Modulating or two-position action.

- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC 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.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- P. Accessories:
 - 1. Auxiliary switches for signaling or position indication.
 - 2. Test and reset switches, remote mounted.

2.11 CORRIDOR DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Ruskin Company.
- B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-hour or 1-1/2-hour rating by an NRTL.
- C. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.
- D. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded or mechanically attached corners.

- F. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel.
- G. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.
- H. Damper Motors: Modulating or two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC 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.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.

2.12 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.13 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dynasonics.
 - 2. Industrial Noise Control, Inc.
 - 3. McGill AirFlow LLC.
 - 4. Ruskin Company.
 - 5. Vibro-Acoustics.
- B. General Requirements:
 - 1. Factory fabricated.
 - 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Shape:
 - 1. Rectangular straight with splitters or baffles.
 - 2. Round straight with center bodies or pods.
 - 3. Rectangular elbow with splitters or baffles.
 - 4. Round elbow with center bodies or pods.
 - 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inch thick.
- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.
 - 1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 - 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 - 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.05 inch thick.
 - 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch-diameter perforations.
- G. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:

- 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
- 2. Film-lined type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
- 3. Lining: Mylar.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Joints: Lock formed and sealed or flanged connections.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
 - 1. Integral 1-1/2-hour fire damper with access door.
 - 2. Factory-installed end caps to prevent contamination during shipping.
 - 3. Removable splitters.
 - 4. Airflow measuring devices.
- L. Source Quality Control: Test according to ASTM E 477.
 - 1. Testingto be witnessed by Architect.
 - 2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
 - 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6inch wg static pressure, whichever is greater.
- M. Capacities and Characteristics:
 - 1. Configuration: Straight or 90-degree elbow.
 - 2. Shape: Rectangular or Round.
 - 3. Attenuation Mechanism: Acoustical glass fiber with protective film liner Helmholtz resonator mechanism with no internal media.
 - 4. Maximum Pressure Drop: 0.35-inch wg.
 - 5. Casing:
 - a. Attenuation: Standard.
 - b. Outer Material: Galvanized steel.
 - c. Inner Material: Galvanized steel.
 - 6. Velocity Range: 1000-2500 fps>.
 - 7. End Connection: Flange.
 - 8. Length: as scheduled.

- 9. Face Dimension: as scheduled.
- 10. Face Velocity: as scheduled.
- 11. Dynamic Insertion Loss: as scheduled.
- 12. Generated Noise: as scheduled.

2.14 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing.
 - 4. METALAIRE, Inc.
 - 5. SEMCO Incorporated.
 - 6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.15 **REMOTE DAMPER OPERATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.

- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Steel.

2.16 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Elgen Manufacturing.
 - 5. Flexmaster U.S.A., Inc.
 - 6. Greenheck Fan Corporation.
 - 7. McGill AirFlow LLC.
 - 8. Nailor Industries Inc.
 - 9. Pottorff.
 - 10. Ventfabrics, Inc.
 - 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:

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- 1. Door and Frame Material: Galvanized sheet steel.
- 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
- 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
- 4. Factory set at 3.0- to 8.0-inch wg Insert value.
- 5. Doors close when pressures are within set-point range.
- 6. Hinge: Continuous piano.
- 7. Latches: Cam.
- 8. Seal: Neoprene or foam rubber.
- 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.17 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.18 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing.
 - 4. Ventfabrics, Inc.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.

- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.19 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 20 to plus 210 deg F.
- C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 20 to plus 210 deg F.
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- D. Flexible Duct Connectors:
 - 1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
 - 2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.20 DUCT SECURITY BARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carnes.
 - 2. KEES, Inc.
 - 3. Lloyd Industries, Inc.
 - 4. Metal Form Manufacturing, Inc.
 - 5. Price Industries.
- B. Description: Field- or factory-fabricated and field-installed duct security bars.
- C. Configuration:
 - 1. Frame: 2 by 1/4 inch flat frame.

- 2. Sleeve: 0.1345-inch continuously welded steel frames with 1-by-1-by-3/16-inch angle frame factory welded to 1 end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
- 3. Horizontal Bars: 1/2 inch.
- 4. Vertical Bars: 1/2 inch.
- 5. Bar Spacing: 6 inches.
- 6. Mounting: Metal deck or roofing Bolted or welded with masonry anchors Ductwork or other framing.

2.21 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Where dampers or equipment that need servicing or adjustment are located behind inaccessible walls, floors, or ceilings, provide an access door in the inaccessible construction to enable servicing of the device.

- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers according to UL listing.
- I. Install duct security bars. Construct duct security bars from 0.164-inchsteel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- J. Connect ducts to duct silencers with flexible duct connectors.
- K. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- L. Install access doors with swing against duct static pressure.
- M. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- N. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- O. Install flexible connectors to connect ducts to equipment.

- P. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- Q. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- R. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- S. Connect flexible ducts to metal ducts with draw bands.
- T. Install duct test holes where required for testing and balancing purposes.
- U. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Round ceiling diffusers.
 - 2. Rectangular and square ceiling diffusers.
 - 3. Perforated diffusers.
 - 4. Louver face diffusers.
 - 5. Linear bar diffusers.
 - 6. Linear slot diffusers.
 - 7. Adjustable bar grilles.
 - 8. Fixed face grilles.
 - 9. Linear bar grilles.
- B. Related Sections:
 - 1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Louver Face Diffuser SD:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Nailor Industries Inc.
 - c. Price Industries.

- d. Titus.
- e. Tuttle & Bailey.
- 2. Devices shall be specifically designed for variable-air-volume flows.
- 3. Material: Aluminum.
- 4. Finish: Baked enamel, white.
- 5. Face Size: See schedule on the drawings.
- 6. Mounting: Surface.
- 7. Pattern: As indicated on the drawings..
- 8. Dampers: None, dampers by MC in branch duct 3'0" from grille.
- 9. Accessories:
 - a. Square to round neck adaptor.
 - b. Adjustable pattern vanes.
 - c. Throw reducing vanes.
 - d. Equalizing grid.
 - e. Plaster ring.

2.2 CEILING LINEAR SLOT OUTLETS

- A. Linear Slot Diffuser LD:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Nailor Industries Inc.
 - c. Price Industries.
 - d. Titus.
 - e. Tuttle & Bailey.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material Shell: Aluminum, insulated.
 - 4. Material Pattern Controller and Tees: Aluminum.
 - 5. Finish Face and Shell: Baked enamel, black.
 - 6. Finish Pattern Controller: Baked enamel, black.
 - 7. Finish Tees: Baked enamel, color selected by Architect.
 - 8. Slot Width: 3/4 inch.
 - 9. Number of Slots: As indicated on the drawings.
 - 10. Length: As indicated on the drawings..
 - 11. Accessories: Plaster frame.
 - 12. Damper: None, dampers by MC in branch duct 3'0" from grille.

2.3 GRILLES

- A. Adjustable Bar Grille SG:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Krueger.
 - c. Nailor Industries Inc.
 - d. Price Industries.

- e. Titus.
- f. Tuttle & Bailey.
- 2. Material: Aluminum.
- 3. Finish: Baked enamel, color selected by Architect.
- 4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
- 5. Core Construction: Integral.
- 6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
- 7. Frame: 1 inch wide.
- 8. Mounting: Countersunk screw.
- 9. Volume damper: None, dampers by MC in branch duct 3'0" from grille.
- B. Fixed Face Register EG:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Krueger.
 - c. Nailor Industries Inc.
 - d. Price Industries.
 - e. Titus.
 - f. Tuttle & Bailey.
 - 2. Material: Aluminum.
 - 3. Finish: Baked enamel, color selected by Architect.
 - 4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
 - 5. Core Construction: Integral.
 - 6. Frame: 1 inch wide.
 - 7. Mounting: Countersunk screw.
 - 8. Damper Type: None, dampers by MC in branch duct 3'0" from grille..
- C. Linear Bar Grille SG:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Krueger.
 - c. Nailor Industries Inc.
 - d. Price Industries.
 - e. Titus.
 - f. Tuttle & Bailey.
 - 2. Material: Aluminum.
 - 3. Finish: Baked enamel, color selected by Architect.
 - 4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
 - 5. Distribution plenum.
 - a. Internal insulation.
 - b. Inlet damper.
 - 6. Frame: 1 inch wide.
 - 7. Mounting: Countersunk screw.
 - 8. Damper Type: None, dampers by MC in branch duct 3'0" from grille..

DIFFUSERS, REGISTERS, AND GRILLES 23 37 13 - 3

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Wall-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. Locate units where indicated on Architectural Drawings. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 81 26 – SPLIT-SYSTEM HEAT 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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 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. Filters: **One** set for each air-handling unit.
 - 2. Gaskets: **One** set(s) for each access door.
 - 3. Fan Belts: **One** set for each air-handling unit fan (if applicable).

1.7 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. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 - 2. Friedrich Air Conditioning Company.
 - 3. Lennox International Inc.
 - 4. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 - 5. Mitsubishi Heavy Industries America, Inc.
 - 6. Trane; a business of American Standard companies.
 - 7. YORK; a Johnson Controls company.
 - 8. Engineer approved equal.

2.2 INDOOR, EXPOSED, WALL-MOUNTED UNITS

- A. Description: Factory-assembled and tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
- B. Cabinet:
 - 1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
 - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
 - 3. Mounting: Manufacturer-designed provisions for field installation.
 - 4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
 - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
 - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
 - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
 - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
 - 5. Unit Internal Tubing: Copper tubing with brazed joints.
 - 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 - 7. Field Piping Connections: Manufacturer's standard.

- 8. Factory Charge: Dehydrated air or nitrogen.
- 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
 - 1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
 - 2. Condensate Removal: Gravity.
 - a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
 - 3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
 - 1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
 - d. Wheels statically and dynamically balanced.
 - 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
 - 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 - 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
 - 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
 - 1. Access: Front, to accommodate filter replacement without the need for tools.
 - 2. Washable Media: Manufacturer's standard filter with antimicrobial treatment.
- G. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in front face of unit cabinet.
- H. Unit Accessories:
 - 1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
 - 2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.
- I. Unit Controls:
 - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.

- 2. Factory-Installed Controller: Configurable digital control.
- 3. Factory-Installed Sensors:
- 4. Features and Functions: Self-diagnostics, time delay, auto-restart.
- 5. Communication: Network communication with other indoor units and outdoor unit(s).
- 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- J. Unit Electrical:
 - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 - 2. Field Connection: Single point connection to power entire unit and integral controls.
 - 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 - 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.3 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
 - 1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
 - 2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
 - 3. All units installed shall be from the same product development generation.
- B. Cabinet:
 - 1. Galvanized steel and coated with a corrosion-resistant finish.
 - 2. Mounting: Manufacturer-designed provisions for field installation.
 - 3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
 - 1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to **15** percent of rated capacity.
 - 2. Protection: Integral protection against the following:
 - a. High refrigerant pressure.

- b. Low oil level.
- c. High oil temperature.
- d. Thermal and overload.
- e. Voltage fluctuations.
- f. Phase failure and phase reversal.
- g. Short cycling.
- 3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
- 4. Vibration Control: Integral isolation to dampen vibration transmission.
- 5. Oil management system to ensure safe and proper lubrication over entire operating range.
- 6. Crankcase heaters with integral control to maintain safe operating temperature.
- 7. Fusible plug.
- D. Condenser Coil Assembly:
 - 1. Plate Fin Coils:
 - a. Casing: Aluminum, galvanized, or stainless steel.
 - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
 - c. Tubes: Copper, of diameter and thickness required by performance.
 - 2. Aluminum Microchannel Coils:
 - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - b. Single- or multiple-pass arrangement.
 - c. Construct fins, tubes, and header manifolds of aluminum alloy.
 - 3. Coating: None.
 - 4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
 - 1. Fan(s): Propeller type.
 - a. Direct-drive arrangement.
 - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
 - c. Statically and dynamically balanced.
 - 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
 - 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.

- 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
- 5. Speed Settings and Control: Variable speed with a speed range of least **75** percent.
- 6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
 - 1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
 - 2. Factory-Installed Controller: Configurable digital control.
 - 3. Factory-Installed Sensors:
 - a. Refrigerant suction temperature.
 - b. Refrigerant discharge temperature.
 - c. Outdoor air temperature.
 - d. Refrigerant high pressure.
 - e. Refrigerant low pressure.
 - f. Oil level.
 - 4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection.
 - 5. Communication: Network communication with indoor units and other outdoor unit(s).
 - 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
 - 1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
 - 2. Field Connection: Single point connection to power entire unit and integral controls.
 - 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 - 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevention corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
 - 1. Unit Tubing: Copper tubing with brazed joints.
 - 2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.

- 3. Field Piping Connections: Manufacturer's standard.
- 4. Factory Charge: Dehydrated air or nitrogen.
- 5. Testing: Factory pressure tested and verified to be without leaks.

2.4 SYSTEM CONTROLS

- A. General Requirements:
 - 1. Network: Indoor units and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
 - 2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
 - 3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:
 - a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.
 - 4. Operator Interface:
 - a. Operators shall interface with system and unit controls through the following:
 - 1) Operator interfaces integral to controllers.
 - 2) Owner-furnished PC connected to central controller(s).
 - 3) Web interface through web browser software.
 - 4) Integration with Building Automation System.
 - b. Users shall be capable of interface with controllers for control of indoor units to extent privileges are enabled. Control features available to users shall include the following:
 - 1) On/off control.
 - 2) Temperature set-point adjustment.
- B. Central Controllers:
 - 1. Centralized control for all indoor and outdoor units from a single central controller location.
 - a. Include multiple interconnected controllers as required.
 - 2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.

- 3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - a. Sets schedule for daily, weekly, and annual events.
 - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
- 4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
- 5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
- 6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
- 7. Service diagnostics tool.
- 8. Able to disable and enable operation of individual controllers for indoor units.
- 9. Information displayed on individual controllers shall also be available for display through central controller.
- 10. Information displayed for outdoor units, including refrigerant high and low pressures .
- 11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
- 12. Operator interface through a backlit, high-resolution color display touch panel.

2.5 SYSTEM REFRIGERANT AND OIL

- A. Refrigerant:
 - 1. As required by HVAC system manufacturer for system to comply with performance requirements indicated.
 - 2. R-410a refrigerant.
- B. Oil:
 - 1. As required by HVAC system manufacturer and to comply with performance requirements indicated.

2.6 SYSTEM CONDENSATE DRAIN PIPING

- A. If more than one material is listed, material selection is Contractor's option.
- B. Copper Tubing:
 - 1. Drawn-Temper Tubing: According to ASTM B88, Type L or Type DWV according to ASTM B306.
 - 2. Wrought-Copper Fittings: ASME B16.22.
 - 3. Wrought-Copper Unions: ASME B16.22.
 - 4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

- C. CPVC plastic pipe according to ASTM F441/F441M, Schedule 40, with socket-type pipe fittings according to ASTM F438 and solvent cement according to ASTM F493.
- D. PVC plastic pipe according to ASTM D1785, Schedule 40, with socket-type pipe fittings according to ASTM D2466 and solvent cement according to ASTM D2564, primer according to ASTM F656.

2.7 SYSTEM REFRIGERANT PIPING

- A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.
- B. Refrigerant Piping:
 - 1. Copper Tube: ASTM B280, Type ACR.
 - 2. Wrought-Copper Fittings: ASME B16.22.
 - 3. Brazing Filler Metals: AWS A5.8/A5.8M.
- C. Refrigerant Tubing Kits:
 - 1. Furnished by HVAC system manufacturer.
 - 2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
 - 3. Standard one-piece length for connecting to indoor units.
 - 4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
 - 5. Factory Charge: Dehydrated air or nitrogen.
- D. Divided-Flow Specialty Fittings: Where required by HVAC system manufacturer for proper system operation, HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- E. Refrigerant Isolation Ball Valves:
 - 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
 - 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
 - 3. Valve Connections: Flare or sweat depending on size.

2.8 METAL HANGERS AND SUPPORTS

- A. Copper Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

- 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized or coppercoated steel.
- B. Plastic Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, galvanized-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.

2.9 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded, zinc-coated steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Indoor Applications: Zinc-coated or stainless steel.
 - 2. Outdoor Applications: Stainless steel.

2.10 OUTDOOR EQUIPMENT STANDS

- A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.
- B. Foot Material: Rubber or polypropylene.
- C. Rails Material: Hot-dip galvanized carbon steel.
- D. Wind/Sliding Load Resistance: Up to 100 mph minimum.

2.11 MISCELLANEOUS SUPPORT MATERIALS

- A. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
- B. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

C. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

2.12 PIPING AND TUBING INSULATION

- A. Comply with requirements in Section 230719 "HVAC Piping Insulation" for system piping insulation requirements.
- B. Condensate Drain Piping and Tubing Insulation and Jacket Requirements:
 - 1. Flexible Elastomeric Insulation:
 - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
 - b. Indoors: 1 inch thick.
 - c. Outdoors:1 inch thick.
 - 2. Field-Applied Jacket:
 - a. None Required.
- C. Refrigerant Tubing Insulation and Jacket Requirements:
 - 1. Flexible Elastomeric Insulation:
 - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
 - b. Indoors: 1 inch thick.
 - c. Outdoors: 1 inch thick.
 - 2. Field-Applied Jacket:
 - a. None Required.
- D. Flexible Elastomeric Insulation Adhesive: Comply with MIL-A-24179A, Type II, Class I.

2.13 SYSTEM CONTROL CABLE AND RACEWAYS

- A. Low-Voltage Control Cabling:
 - 1. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
- B. TIA-485A Network Cabling:
 - 1. Standard Cable: NFPA 70, Type CMG.

- 2. Plenum-Rated Cable: NFPA 70, Type CMP.
- C. Ethernet Network Cabling: TIA-568-C.2 Category 6 cable with RJ-45 connectors.
- D. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for control wiring and cable raceways.

2.14 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.

2.15 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Clearance:
 - 1. Maintain manufacturer's recommended clearances for service and maintenance.
 - 2. Maintain clearances required by governing code.

- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
 - 1. Loose components shall be installed by system Installer under supervision of manufacturer's service representative.
- C. Indoor Unit Installations:
 - 1. Install units to be level and plumb while providing a neat and finished appearance.
 - 2. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
 - 3. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
 - 4. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
 - 5. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
 - 6. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
 - 7. Attachment: Install hardware for proper attachment to supported equipment.
- D. Outdoor Unit Installations:
 - 1. Install units to be level and plumb while providing a neat and finished appearance.
 - 2. Install outdoor units on support structures indicated on Drawings.
 - 3. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - a. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
 - b. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.2 GENERAL REQUIREMENTS FOR PIPING AND TUBING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 CONDENSATE DRAIN PIPE AND TUBING INSTALLATION

- A. General Requirements for Drain Piping and Tubing:
 - 1. Install a union in piping at each threaded unit connection.
 - 2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
 - 3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
 - a. Details indicated on Drawings.
 - b. Manufacturer's requirements.
 - c. Governing codes.
 - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
 - 4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
 - 5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.
- B. Gravity Drains:

- 1. Slope piping from unit connection toward drain termination at a constant slope of not less than **one** percent.
- C. Pumped Drains:
 - 1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.4 REFRIGERANT PIPING AND TUBING INSTALLATION

- A. Refrigerant Tubing Kits:
 - 1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
 - 2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
 - 3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.
- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by HVAC system manufacturer, slope refrigerant piping and tubing as follows:
 - 1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.

- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by HVAC system manufacturer.
- K. Joint Construction:
 - 1. Ream ends of tubes and remove burrs.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
 - 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
 - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
 - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.5 PIPE AND TUBING INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.
- B. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of 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.
- C. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. 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.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of manufacturer's service representative:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 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.
- B. Refrigerant Tubing Positive Pressure Testing:
 - 1. Comply with more stringent of HVAC system manufacturer's requirements and requirements indicated.
 - 2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.5 times HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
 - 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
 - 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
 - 5. Submit test reports for Project record.
- C. Refrigerant Tubing Evacuation Testing:
 - 1. Comply with more stringent of HVAC system manufacturer's requirements and requirements indicated.
 - 2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.

- 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of **one** hour(s) with no change.
- 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
- 5. Submit test reports for Project record.
- 6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.
- D. System Refrigerant Charge:
 - 1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
 - 2. Installer shall charge system following HVAC system manufacturer's written instructions.
 - 3. System refrigerant charging shall be witnessed by system manufacturer's representative.
 - 4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.
- E. Products will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a HVAC system manufacturer's service representative to perform system(s) startup service.
 - 1. Service representative shall be a factory-trained and -authorized service representative of HVAC system manufacturer.
 - 2. Complete startup service of each separate system.
 - 3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:

- 1. Check control communications of equipment and each operating component in system(s).
- 2. Check each indoor unit's response to demand for cooling and heating.
- 3. Check each indoor unit's response to changes in airflow settings.
- 4. Check each indoor unit and outdoor unit for proper condensate removal.
- 5. Check sound levels of each indoor and outdoor unit.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
 - 1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
 - 1. After completion of startup service, manufacturer shall issue a report for each separate system.
 - 2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
 - 3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.
 - a. All available system operating parameters shall be included in the information submitted.

3.9 ADJUSTING

- A. Adjust equipment and components to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to HVAC system manufacturer's written instructions, and as indicated.

3.10 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.11 **DEMONSTRATION**

A. Engage a HVAC system manufacturer's employed training instructor to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

END OF SECTION 23 81 26

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 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.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For sleeve seals.

1.4 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 device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Co.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. 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.
 - 3. Pressure Plates: Carbon steel. 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 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

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2 and Type THHN-2-THWN-2.
- C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- 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. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway or Type MC for normal power circuits.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- G. Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 **IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements: provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Dossert; AFL Telecommunications LLC.
 - 3. ERICO International Corporation.
 - 4. Fushi Copperweld Inc.
 - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 6. Harger Lightning and Grounding.
 - 7. ILSCO.
 - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 - 9. Robbins Lightning, Inc.
 - 10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:

- 1. Solid Conductors: ASTM B 3.
- 2. Stranded Conductors: ASTM B 8.
- 3. Tinned Conductors: ASTM B 33.
- 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
- 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
- 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, as sized per drawing.
 - 1. Bury at least 24 inches (600 mm) below grade.

- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods around the pad. Ground padmounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for taps to equipment grounding terminals.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches (300 mm) deep, with cover.

- 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 ACTION SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 - g. Wesanco, Inc.
 - Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

- 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 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) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 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) Cooper B-Line, Inc.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 7. To Light Steel: Sheet metal screws.

- 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.

- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ENT: Comply with NEMA TC 13 and UL 1653.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Fittings for LFNC: Comply with UL 514B.
- I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- J. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, 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.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Cast-Metal Galvanized Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Metal Floor Boxes:
 - 1. All specified on drawings.
 - 2. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Luminaire Outlet Boxes: CAST METAL GALVANIZED Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA 4.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: Double gang: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) or Single gang: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel NEMA 4, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel NEMA 4; all sides finished with manufacturer's standard enamel.
- K. 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.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Standard: Comply with SCTE 77.
 - 2. Color: Green in landscape areas. Grey in concrete areas.
 - 3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
 - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 6. Cover Legend: Molded lettering, "ELECTRIC", "TELEPHONE" or as indicated for each service.
 - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of reinforced concrete or cast iron or fiberglass.
 - 1. Standard: Comply with SCTE 77.
 - 2. Color: Green in landscape areas. Grey in concrete areas.
 - 3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
 - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 6. Cover Legend: Molded lettering, "ELECTRIC", "TELEPHONE" or as indicated for each service.
 - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC IMC RMC
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit: RNC or Type EPC-80-PVC concrete encased.
 - 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.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
 - 1. Exposed, Not Subject to Physical Damage: EMT or RMC.
 - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT or RMC.
 - 3. Damp or Wet Locations: GRC or IMC.
 - 4. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (16-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. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use compression, fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hotwater pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- 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. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change to RNC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. 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.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

- O. Install raceway sealing fittings at accessible locations according to NFPA 70 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.
- P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- Q. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
 - 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC conduits.
 - 3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- R. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed luminaires, 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.
- S. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- T. 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. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- U. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- V. Locate boxes so that cover or plate will not span different building finishes.
- W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

- X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Y. Set metal floor boxes level and flush with finished floor surface.
- Z. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less, including Telephone, Communications, and Data Wiring:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer concrete frame and cover, SCTE 77, Tier 15 structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 structural load rating.
 - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fireresistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
- b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements,:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements,:
 - a. Presealed Systems.
 - b. Or approved equal.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-firerated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install 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.

3.3 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 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.

- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

- 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trenchexceeds 16 inches (400 mm) overall.
- G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 10-foot (3-m) maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

- 1. Color-Coding for three Phase Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
 - a. Color shall be factory applied.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Selfadhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Emergency system boxes and enclosures.
 - h. Enclosed switches.
 - i. Enclosed circuit breakers.
 - j. Enclosed controllers.
 - k. Variable-speed controllers.
 - 1. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Snap switches.
 - 4. Wall-switch occupancy sensors.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

- 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:
- 2. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
- 3. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
- 4. Leviton Mfg. Company Inc. (Leviton).
- 5. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Products: Subject to compliance with requirements:
 - a. Cooper; 5351 (single), CR5362 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, non-feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements:
 - a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.
 - d. Leviton; 7590.

2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - 1) Single Pole:
 - 2) Cooper; AH1221.
 - 3) Hubbell; HBL1221.
 - 4) Leviton; 1221-2.
 - 5) Pass & Seymour; CSB20AC1.
 - 6) Three Way:
 - 7) Cooper; AH1223.
 - 8) Hubbell; HBL1223.
 - 9) Leviton; 1223-2.
 - 10) Pass & Seymour; CSB20AC3.

2.6 DECORATOR-STYLE DEVICES

- A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements:
 - a. Cooper; 6252.
 - b. Hubbell; DR15.
 - c. Leviton; 16252.
 - d. Pass & Seymour; 26252.
- B. GFCI, Non-Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.
 - 1. Products: Subject to compliance with requirements:
 - a. Cooper; VGF15.

- b. Hubbell; GF15LA.
- c. Leviton; 8599.
- d. Pass & Seymour; 1594.
- C. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Cooper; 7621 (single pole), 7623 (three way).
 - b. Hubbell; DS115 (single pole), DS315 (three way).
 - c. Leviton; 56291-2 (single pole), 5623-2 (three way).
 - d. Pass & Seymour; 2621 (single pole), 2623 (three way).

2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weatherresistant thermoplastic with lockable cover.

2.8 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:

- 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
- 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
- 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- 4. Install wiring devices after all wall preparation, including painting, is complete.
- 5. All guest room receptacles shall be mounted horizontally except above kitchen counter.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. 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."

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

- 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, 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.
- E. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Manufacturer's field service report.
- G. Operation and Maintenance Data: For enclosed switches and circuit breakers 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. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

- 3. Siemens Energy & Automation, Inc.
- B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight red ON pilot light.
 - 3. Isolated neutral lug; 100 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I²t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - 8. Electrical Operator: Provide remote control for on, off, and reset operations.

2.5 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.

- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

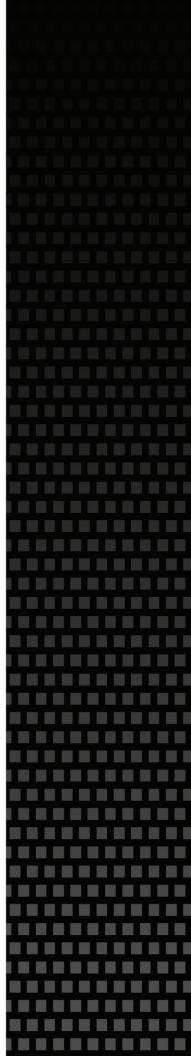
- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

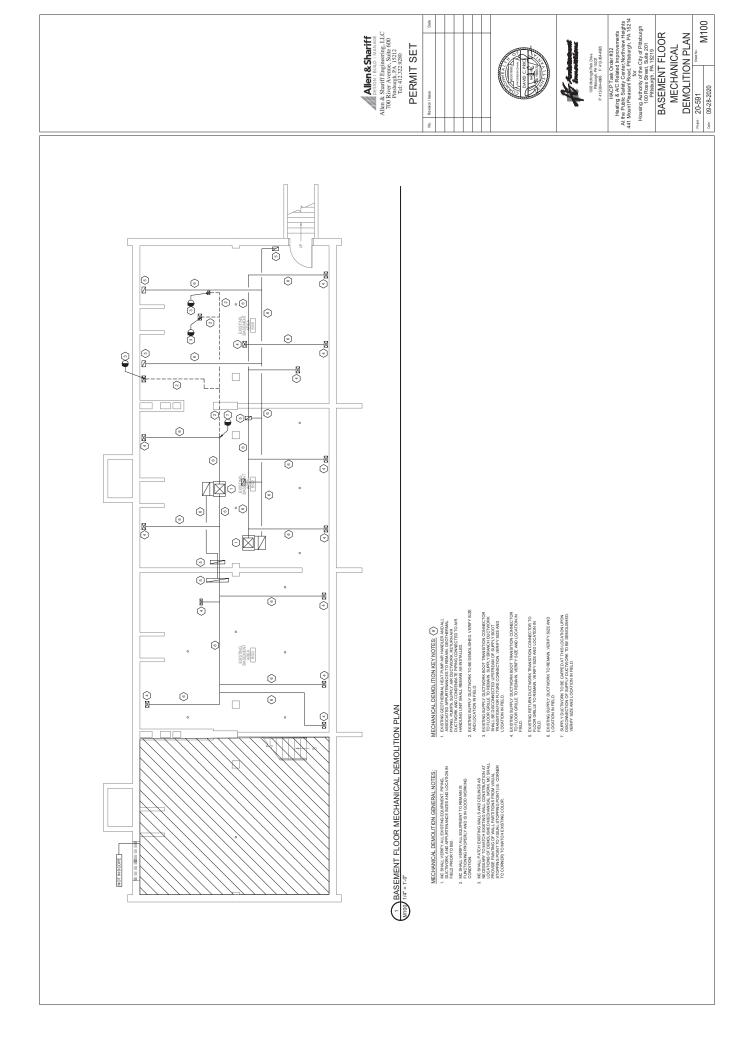
A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

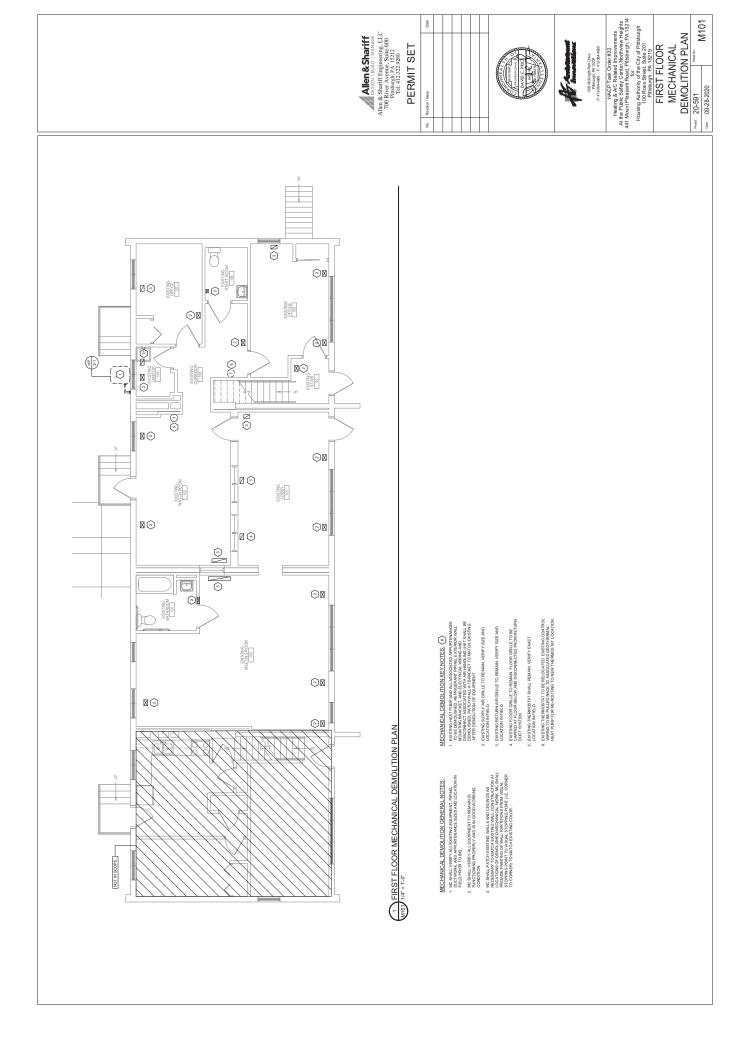
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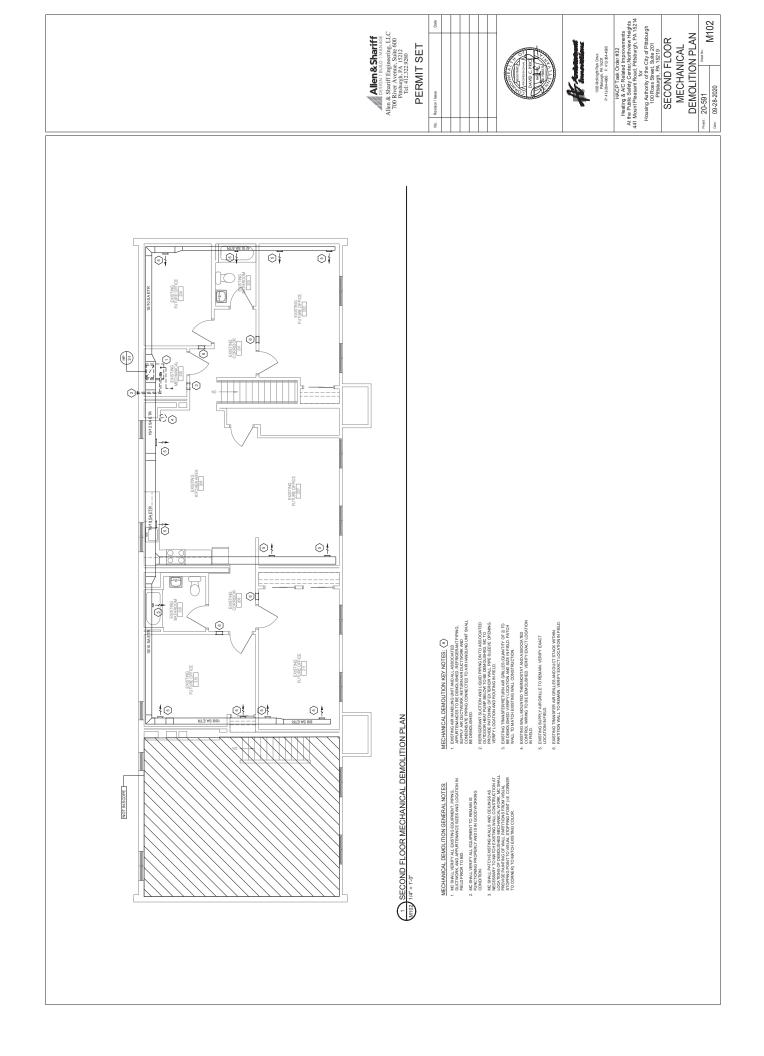


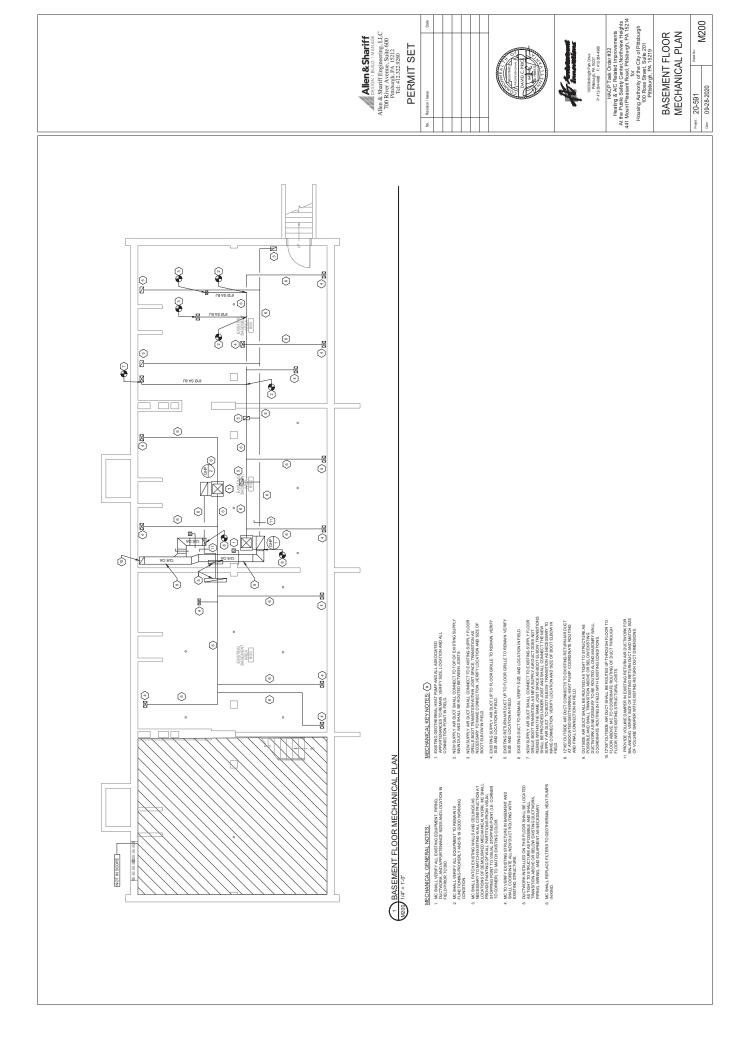
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|---|--|---|---|
| HACP Task Order #32 Heating & A/C Related Improvements At the Public Safety Center, Northview Heights 441 Mount Pleasant Road, Pittsburgh, PA 15214 for Housing Authority of the City of Pittsburgh 100 Ross Street, Suite 201 Pittsburgh, PA 15219 | Architect ARCHITECTURAL INNOVATIONS, LLC 1003 MKKright Park Drive Pittsburgh, PA 172.27 Phone: 412-364-4966 Contact: James Johnston | HVAC / Electrical ALEVAC ALENCIF 2008 Biter Avenue 306 800 Pense Art 72-2229 Prove Art 72-2229 Contact: Alexander Radicoff P.E. | MANUALINA |

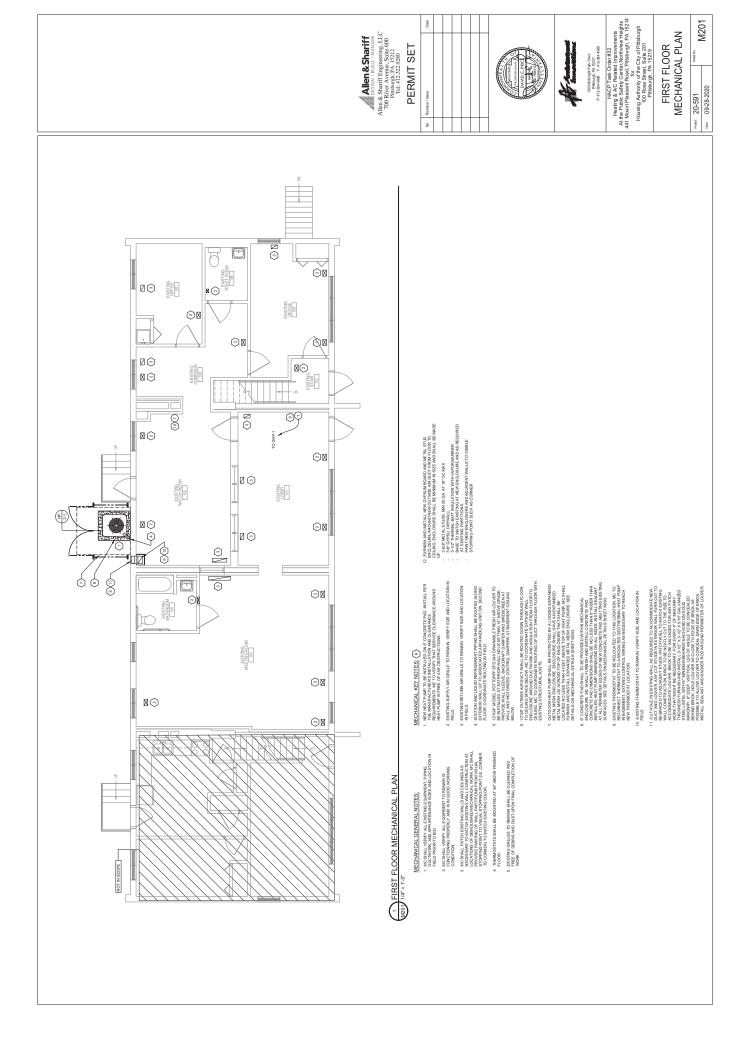
| GENERAL MECHANICAL NOTES (ALL DRAWINGS): MATERALS AND CONTRACTOR SHALL PROVINE AL MATERALS AND FOLIEMENT | MECHANICA SYMBOL A | MECHANICAL DUCTWORK & GENERAL SYMBOLS LEGEND SYMBOL ABRV. DESCRETION | SYMBOL | MECHANICAL PIPING SYMBOLS LEGEND ABRV. DESCRIPTION | | MECHANICAL ABBREVIATIONS ABRV. DESCRIPTION | |
|--|---|---|----------|---|------------------|---|--|
| AND PERFORM ALL LABOR REQUIRED TO INSTALL COMPLETE AND OPERABLE HVAC SYSTERAS MIDIONTED ON THE DRAWINGS, AS SPECIFIED AND DEMUNDED BY COME | 1 | XTR EXISTING EQUIPMENT OR DUCTWORK TO REMAIN | | HWS HEATING WATER SUPPLY PIPING | | HVAC HEATING, VENTILATION AND AIR CONDITIONING MBH 1000, BRITIGHTHEMALLI INITS | |
| REGUINED BY COULE. 2. THE CONTRACT DOCUMENT DRAWINGS ARE DIAGRAMMATIC ONLY, AND ARE | ТМ | RX EXISTING EQUIPMENT OR DUCTWORK TO BE REMOVED | HWR | HWR HEATING WATER RETURN PIPING | | | |
| INTENDED TO CONVEY THE SCOPE AND GENERAL ARRANGEMENT OF WORK. 3. ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE VERFIED BY THE | ľ | NEW EQUIPMENT OR DUCTWORK | | CWS CONDENSER WATER SUPPLY PIPING | | SENS. SENSIBLE | |
| CONTINUED REFERENCES CONTINUED NOT NEXT THE NUMBER OF THE | 1 | LINED DUCTWORK | CWR | CWR CONDENSER WATER RETURN PIPING | | | |
| THIS BUT PROLET THE COST IN OWN OWN RECARD. FALL THIS WALLUND OF THIS OF OTHER TRADES, THAT IN THERE REE, ALL WORK SHALL BE COORDIMATED WITH ALL TRADES INVOLVED. ALL OFFSETS, FRSES, TRANSITIONS AND DROPS | | SUPPLY DUCT UP | | CHWS CHILLED WATER SUPPLY PIPING | | L.A.T. LEAVING AIR TEMPERATURE F.W.T. ENTERNO WATER TEMPERATURE | |
| IN DUCTS AND PPING AROUND OBSTRUCTIONS SHALL BE PROVIDED AT NO ADDITIONAL COST TO THE OWNER. | | SUPPLY DUCT DOWN | 1 | | | | |
| VERIEY ALL EQUIPMENT CONNECTIONS WITH MANUFACTURERS CERTIFIED DRAWINGS VEREY AND PROVE DUCT TAXARITIONS OF PRE ADAPTIES TO EXIMANCE TO CONNECTION FOR TO VICEOR AND CONDUCT AND TAXARISTICS. | | RETURN / EXHAUST DUCT UP | 0 | G NATURAL GAS PIPIING | | DB/WB DRY BULB / WET BULB IN, W.G. INCHES WATER GAUGE (AIR) | |
| | 10 | RETURN / EXHAUST DUCT DOWN | | | | | |
| PROVIDE ACCESS IN WALLS & CELINIOS TO ACCESS ALL EXUIPIENT, VALVES, CONTROL DEVICES, VOLLINE DAMPERS, AND FIREISMOKE DAMPERS. | jĜ | ROUND DUCT ELBOW UP | | | | E.S.P. EXTERNAL STATIC PRESSURE T.S.P. TOTAL STATIC PRESSURE | |
| FOLLOW MANUFACTURES RECOMMENDATIONS FOR INSTALLATION OF EQUIPMENT, ALSO REFER TO TYPICAL DETAILS FOR INSTALLATION OF DOWNLOAD TO THE DETAILS FOR INSTALLATION OF | I Ç | ROUND DUCT FLEOW DOWN | + | + | (0.15 PSIG) | TG TRANSFER GRILLE | |
| E CUIMMENT. 7. ALL MATERIALS FURNISHED, AND ALL WORK PERFORMED BY THE ME CHANICAL | ĴĖ | | | | (0-10-016) | TR TOP REGISTER (E) EXISTING | |
| CONTRACTORS SHALL BE IN ACCORDANCE WITH ALL APPLICABLE CODES AND CONTRACTORS SHALL BE IN ACCORDANCE WITH ALL APPLICABLE CODES AND REGULATIONS, NALQUING BIL ADVITUATED TO THE ALTER APPLICABLE PERIODATION AND ALL ADVITABLE OF ALL ADVITABLE OF APPLICABLE CODES AND REGULATIONS, NALQUING BIL ADVITABLE OF ALL ADVITABLE OF APPLICABLE PERIODATION AND ALL ADVITABLE OF ALL ADVITABLE OF APPLICABLE CODES AND REGULATIONS, NALQUING BIL ADVITABLE OF ALL ADVITABLE OF APPLICABLE OF APPLICABLE PERIODATION AND ALL ADVITABLE OF ALL ADVITABLE OF APPLICABLE OF APPLICABLE REGULATIONS, NALQUING BIL ADVITABLE OF ALL ADVITABLE OF APPLICABLE OF APPLICABLE OF APPLICABLE OF APPLICABLE OF ALL ADVITABLE OF ALL ADVITABLE OF ALL ADVITABLE OF APPLICABLE | | ELBOW WITH TURNING VANES | | | NG (1660 PSIG) | | |
| E DI KAN GYE NEPA, IEEE, OSHA, SMACKA, INTERNATISMAI, ME CHANON, CODE, INTERNATIONAL BUILDING CODE, AND ANY STATE, COUNTY, AND LOCAL CODES. | | DUCTOFFSETUP | 1 | - | (61 TO 200 PSIG) | UNO UNLESS NOTED OTHERWISE NTS NOTTO SCALE | |
| ALL EQUIPMENT, DUCTWORK, ETC., SHALL BE SUPPORTED SUFFICIENTLY AND ANY ADDITIONAL SUPPORT SHALL BE PROVIDED AS REQUIRED TO PROVIDE | | DUCT OF FSET DOWN | | LPR LOW PRESSURE STEAM CONDENSATE RETURN | ETURN | NIC NOT IN CONTRACT | |
| VIBATTON PREE AND SAFE MAYLLATTON. AL MISCELLAROUS STEEL REQUIRED ANDROR AS SHOWN IN DETAILS FOR DUCTWORK, AND EQUIMART UNL ESS OTTERMISE NOTED SHALL BE FURNISHED AND INSTALL DB YTHE | Å | SQUARE / RECTANGULAR DUCTTRANSITION | | MPR MEDIUM PRESSURE STEAM CONDENSATE RETURN | E RETURN | Ø OR PH PHASE | |
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| | | OD CEILING DIFFUSER ROUND NECK - # THROW DIRECTIONS | 2 | PC PUMPED STEAM CONDENSATE | MOTEO | ELEV. ELEVATION FROM DATUM | |
| ALL CONTROL WRE AND CONDULT SHALL COMPLY WITH NEC AND ELECTRICAL SPECIFICATIONS FOR THIS PROJECT. | | SD SUPPLY DIFRUSER - RECTANGULAR - MULTL-DIRECT. | | V VENTPIPING | 1.NOTJ | NOT ALL SYMBOLS AND ABBREVIATIONS ARE IN USE FOR THIS PROJECT. | |
| DUCTWORK GENERAL NOTES (ALL DRAWINGS): | * 廿- 廿 | SG/EG SIDEWALL SUPPLY or RETURN GRILLE - (R = REGISTER) | | CW CITY (DOMESTIC) WATER | | | |
| ALL DUCTWORK INDICATED IS SCHEMMITC AND SHOW ONLY RELATIVE DOSTITIVAS DEONUTED CREETED SISCE TO ASSITUATE AND RELAVINE DOSTITIVAS. | | LINEAR DIFFUSER. SEE SCHEDULE FOR INFORMATION | -Fos- | FOS FUEL OIL SUPPLY PIPING | | | |
| | | RG/EG RETURN or EXHAUST GRILLE - (R = REGISTER) | FOR | FOR FUEL OIL RETURN PIPING | | | |
| PROVIDE PACES DOORS IN DUI FINOR POR VERNATION, AUUS INPORT, ANU MANNERMACE OF ALL HVAC DEVICES, FINS, DAMPERS, (FIRE, SMOKE, BALANCING) COLLS, AND TERMINAL EQUIPMENT. | ##### | FLEXIBLE DUCT | Î | ELBOW TURNED UP | | | |
| LOCATIONS OF TERMINAL DEVICES, ARY OUTLETS AND INLETS ARE APPROXIMATE. LOCATE PER THE ARCHITECURAL DRAWINGS AND TO ANOID | Ŭ | FLEX FLEXIBLE DUCT CONNECTION (TO EQUIPMENT) | Î | ELBOW TURNED DOWN | | | |
| OTHER PRADES WORK. 000RDIM/TELLOCADING WITH OTHER PRADES. 00NSULT ARCHITECITENGINEER FOR CLARFICATION IF CONFLICTS OCCUR. | + | SPIN TAP WITH VOLUME CONTROL DAMPER | ¢- | BOTTOM PIPE CONNECTION | | | |
| DUCT DIMENSIONS SHOWN ARE CLEAR INSIDE FACE-TO-FACE DIMENSIONS AND DO NOT TAULOE DUCT. NHER WHERE SECRETE. INCLEASE TAURATORY OF ILVED THICT APPROVED FREE INSIDE APPECTIAL | 40V x x 40 | AD DUCTACCESS DOOR | Ļ | TOP PIPE CONNECTION | | | |
| DIMENSIONS SHOWN, REFERTO THE SPECIFICATIONS FOR LOCATION OF LINED DUCTWORK. | Ĥ | VD VOLUME CONTROL DAMPER | Ţ | PIPING CAP | | | |
| FRVAL CONNECTIONS FROM HIGH VELICITY MAN DUCTS TO ARETERMINAL UNITS SHALL BE MADE WITH FLEXIBLE DUCTWORK NOTEXCEEDING 3 FEET IN | | BDD BACKDRAFT DAMPER | ļ | NON | | | Allen & Shariff Engineering, LLC 700 River Avenue, Suite 600 |
| LENGTH. CONNECTION BETWEEN LOW VELOCITY DUCITYOD KAND/OR TERMINAL UNITS TO AIR MILETS AND OUTLETS SHALL BE MADE WITH FLEXELE DUCTIVOSK NOT EXCEEDING 6 FEET IN LENGTH. LONGER DUCT FUN OUTS | E Handrein (1997) The second seco | MD MOTORIZED DAMPER | + | FLANGED CONNECTION | | | Pittsburgh, PA 15212 Tel: 412.322.9280 |
| SHALL BE CONSTRUCTED OF HARD DUCTOF THE SAME MATERIAL, SPECHED FOR THE SYSTEM SERVED AND INSULATED AS SPECHED FOR THAT SYSTEM, R.EX.BUE, DUCTWORK SHALL BE OF THE PRESSURE (LASS AND FACTORY) | Ţ | FD VERTICAL FIRE DAMPER (WALL) | ł | CONCENTRIC PIPE REDUCER | | | PERMIT SET |
| INSULATED AS SPECIFIED FOR THE SYSTEM WHERE INSTALLED. R EVEN F FINTTWORK SHALL BE ASTALLED ALACCOMPANYS WITH THE | • | HFD HORIZONTAL FIRE DAMPER (R. OOR) | 4 | ECCENTRIC PIPE REDUCER | | | No. Revision / Issue Date |
| MANUFACTURES INTRUCTIONS WITHOUT ANY SAGE SHAP THEN CO MANUFACTURES INTRUCTIONS WITHOUT ANY SAGE SHAP THEN CO KINKS, ATTACH SHAP THE FERSILE OF CONTONNESS SHAPE TO FUNDATION THE MANUAL THE FERSILE OF CONTONNESS SHAPE TO SAFE TO THE MANUFACTURES INTO THE AND ANY CONTONNESS SHAPE TO SAFE TO SAFE ANY CONTON THE ANY ANY CONTONNESS SHAPE TO SAFE TO SAFE TO SAFE TO SAFE ANY CONTON THE ANY ANY CONTON TO SAFE TO ANY CONTON THE ANY ANY CONTON TO SAFE | Ĭ | SD VERTICAL SMOKE DAMPER (MALL) | 4 | FLOW ARROW | | | |
| | Ŷ | HSD HORIZONTAL SMOKE DAMPER (FLOOR) | + | BV BALL VALVE | | | |
| PROVIDE VOLUME DAVPERS AT EACH AR OUTLET, AR THET AAD TERNINAL DEVICE AND AT EACH BRANCH TAKE-OFF CONNECTION FROM THE MAIN. | ¥ | FDISD COMBINATION VERTICAL FIRE & SMOKE DAMPER | | BPV BUTTERRLY VALVE | | | |
| MECHANICAL PIPING GENERAL NOTES (ALL DRAMINGS): | | HEDISD COMBINATION HORIZON TAL FIRE & SMOKE DAMPER | ⊥⊉⊤ | PV PLUG VALVE | | | |
| ALL PIPING SHOWN HAS BEEN DRAWN SCHEMATICALLY FOR CLARITY AND PLANNING SHOWN HAS BEEN DRAWN SCHEMATICALLY FOR CLARITY AND | * | RD CEILING RADIATION FIRE DAMPER | H¥ | GV GATE VALVE | | | |
| | 00 | DD DUCTSMOKE DETECTOR | | GBV GLOBE VALVE | | | Convert 1 |
| ALL NEW OR REPLACED HYDROWO PPINNS SHALL BE INSTALLED SO THATTI CAN BE COMPETELY VIENTED AT HIGH POWITS AND DRAVED AT HOUNDS PROVIDE ARI VIENTS AT HIGH POWITS TYPE DER SPECIFICATIONS. REOVIDE | Θ | THERMOSTAT | ł | CV CHECK VALVE | | | A REGISTRATION AND A REGISTRATIONA AND A REGISTRATION AND A REGISTRATIONA AND A REGISTRATION AND A REGISTRAT |
| 112" BALL VALVES WITH HOSE END CONNECTIONS AND CAPS AT LOW POINT. ALL WATER MAINS SHALL BE NSTALLED LEVEL, UNLESS OTHERWISE NOTES. | œ | HUMIDISTAT | ₽¥ | 2-WAY CONTROL VALVE | | | DAVID C. PRICE |
| PROVIDE SERVICE VALVES AT EACH BRANCH CONNECTION PROMIMANS AND AT EACH TERMINAL DEVICE OR EQUIPMENT CONNECTION | ٩ | STATIC PRESSURE SENSOR | ** | 3-WAY CONTROL VALVE | | | |
| CONTRACTOR SHALL PROVIDE NEW VAL VES ON EXSTING PIPING WHERE THE PIPIES ARE TO BE REMAVED SO THATTHE SYSTEM DOES NOT HAVE TO BE | ٢ | CARBON DIOXIDE SENSOR | + | CIRCUIT SETTER (BALANCING VALVE) | | | |
| DRAINED MHILE REMOVING EXISTING UNITS, INSTALLING NEW UNITS AND MAKING GONNECTICARS TO NEW EQUIPMENT. | 3 | CARBON MONOXIDE SENSOR | <i> </i> | STRAINER (W/ BALL VALVE AND CAP) | | | Kenne |
| | | EQUIPMENT UNIT DESIGNATION | ł | BACKFLOW PREVENTER | | | and the second |
| | TAG CFM | DIFFUSER, REGISTER & GRILLE UNIT DESKAWTION W/ CFM | W CFM | PRESSURE REGULATING VALVE | | | 1003 MdGright Park Dive |
| | 9 | UNDER CUT DOOR | * | PRESSURE RELIEF VALVE | | | P. 412.394-4906 F. 412.394-4906 |
| | ¢ | LOUVERED DOOR | 4 | TRPLE DUTY VALVE WITH MEASURING CONNECTIONS | ONNECTIONS | | HACP Task Order #32 Heating & A/C Related Improvements |
| | • | CONNECTION POINT, NEW TO EXISTING | 64 | PRESSURE GAGE WI SHUT-OFF | | | At the Public Safety Center, Northview Heights 441 Mount Pleasant Road, Pittsburgh, PA 15214 |
| | • | DISCONNECTION POINT | | FLEXIBLE CONNECTOR | | | Housing Authority of the City of Pittsburgh 100 Ross Street, Suite 201 |
| | Ĵ | DRAWING KEY NOTE | * | AUTOMATIC AIR VENT | | | Pittsburgh, PA 15219 |
| | Θ | DEMOLITION DRAWING KEY NOTE | f | HOSE BIB | | | MECHANICAL |
| | \triangleleft | REVISION NUMBER | * | PIPE ANCHOR | | | DATA SHEET |
| | AR RA | RA or EA RETURN OR EXHAUST AIR |)(| PIPE GUIDE | | | Project: 20-591 Sheet hui: |
| | \$ | SA or OA SUPPLY OR OUTSDIE AIR | ¢ | STEAM TRAP | | | Date: 09-28-2020 MIUU1 |
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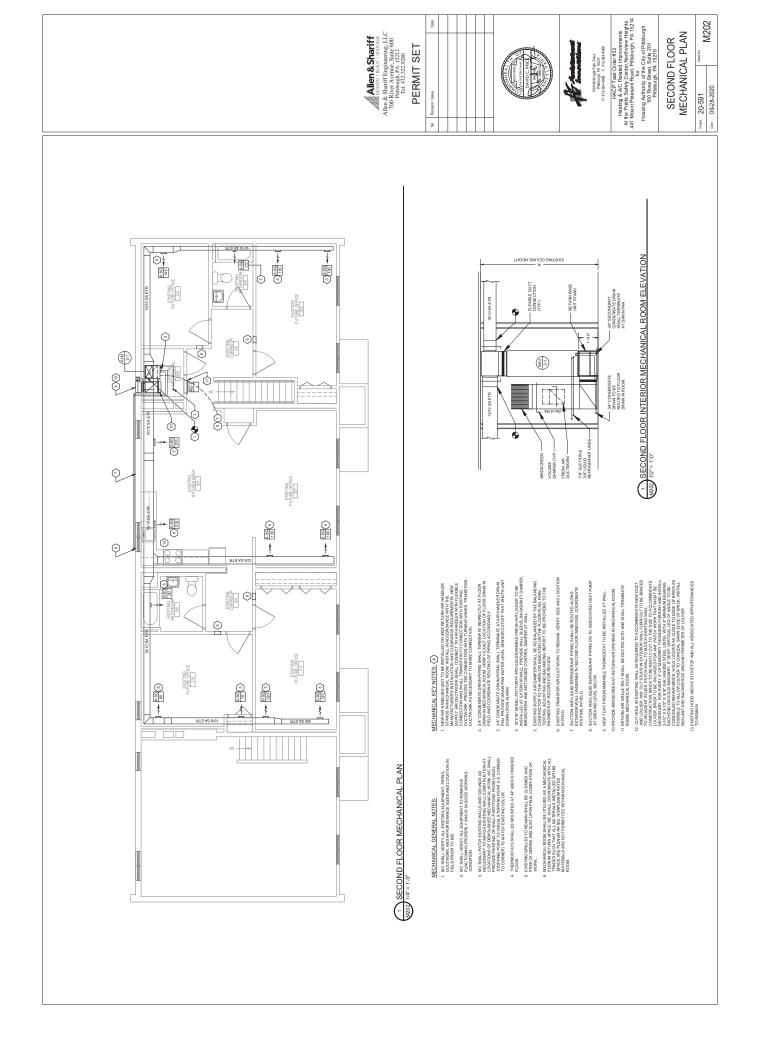


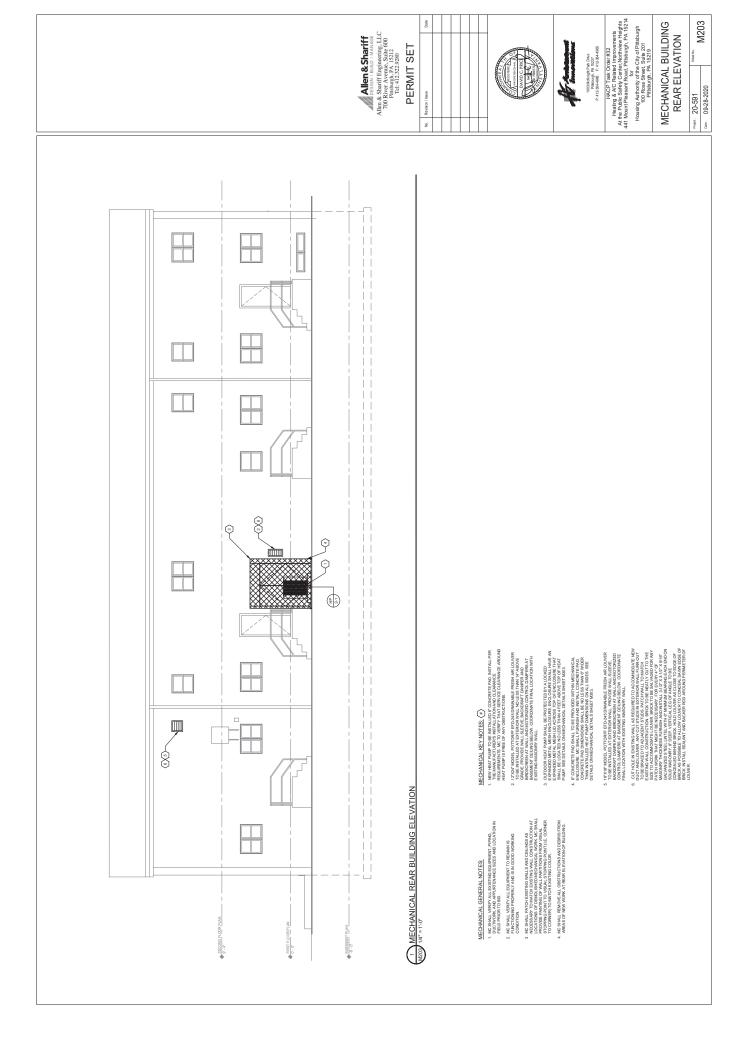


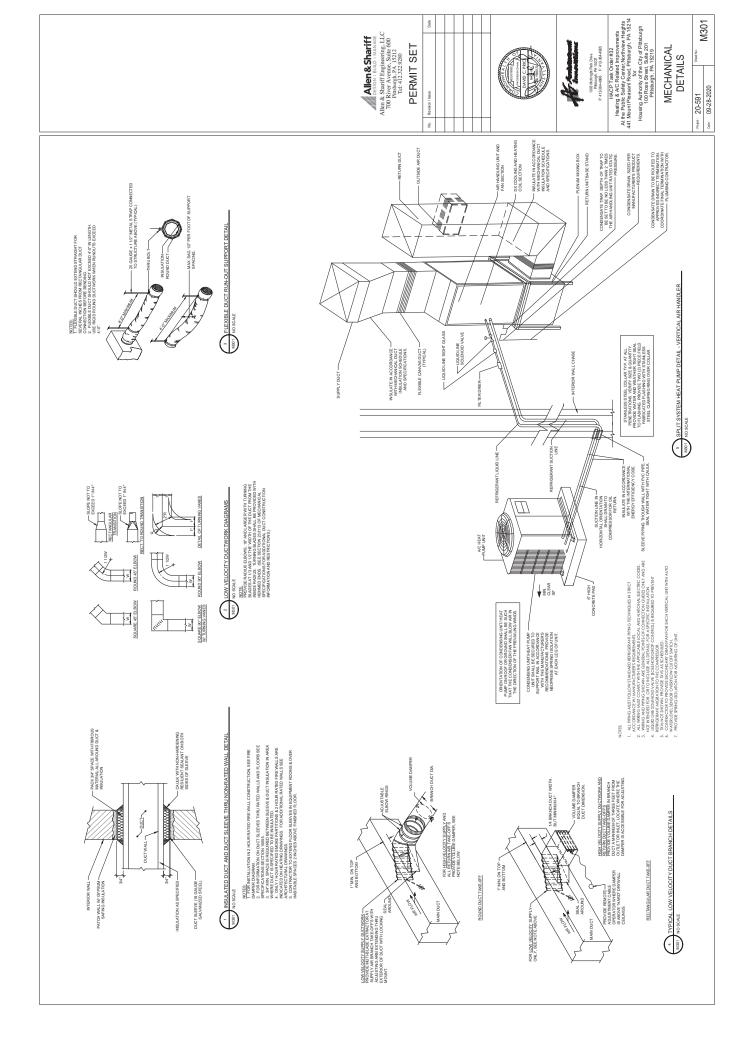


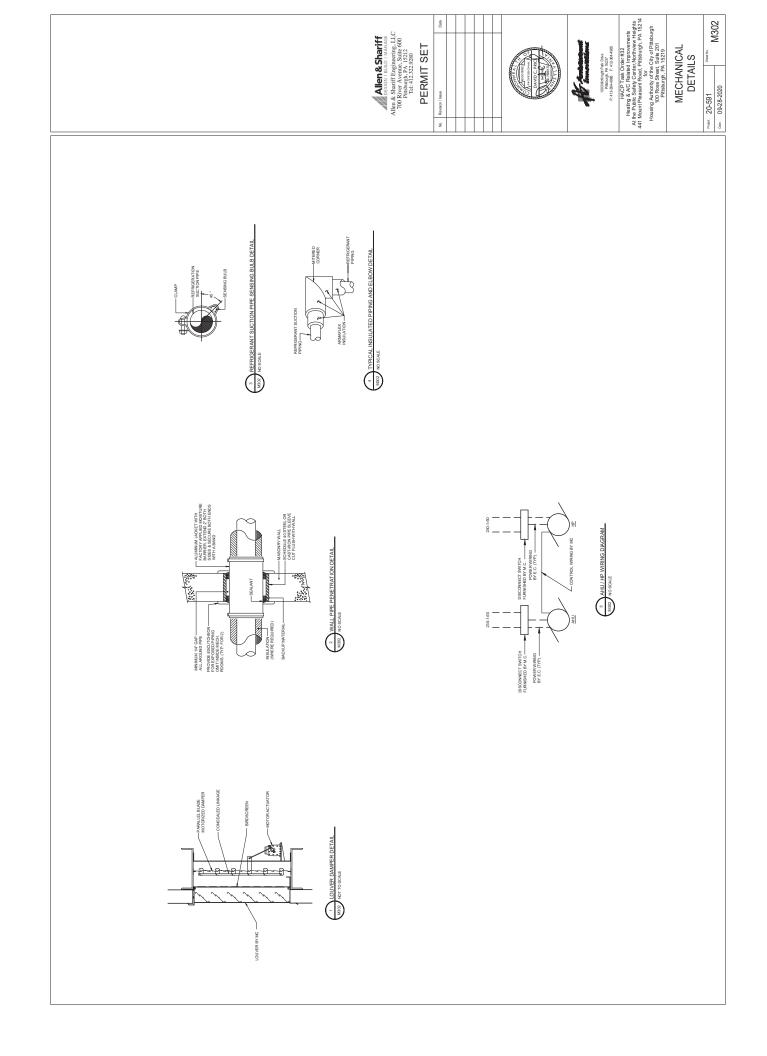


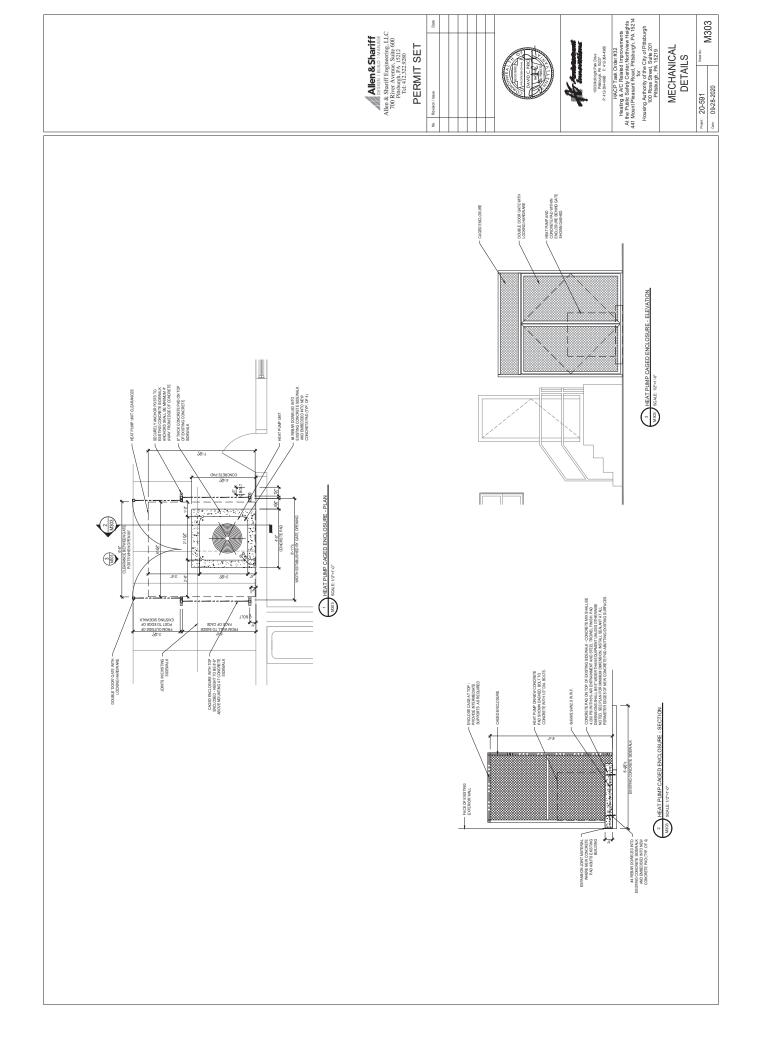








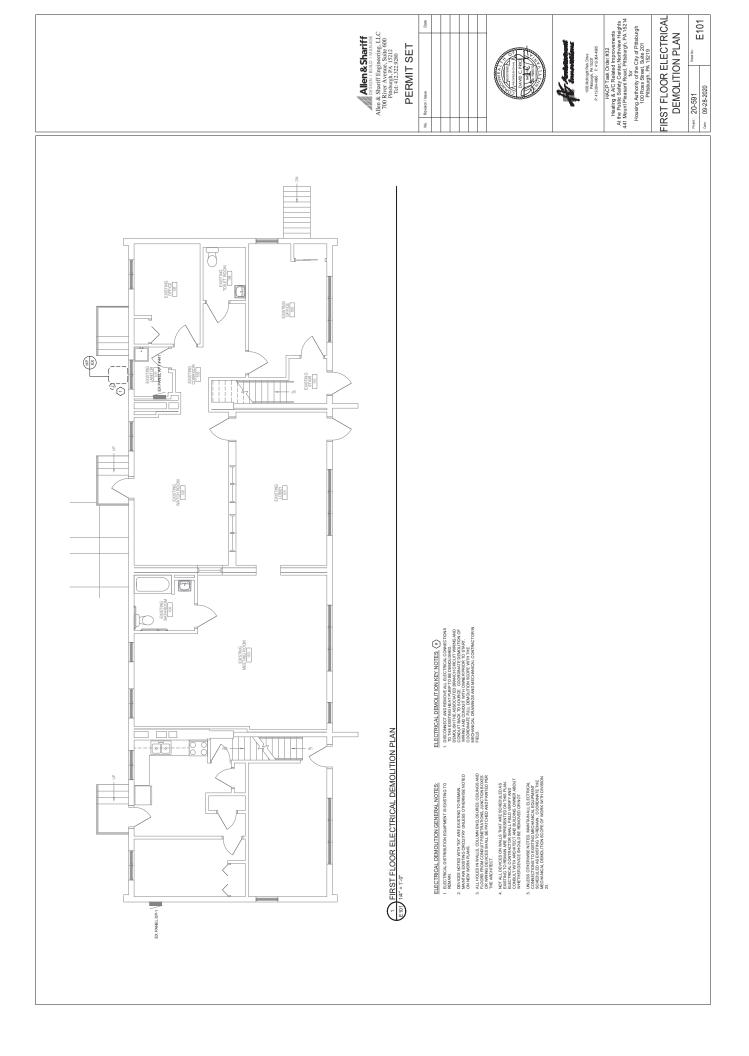


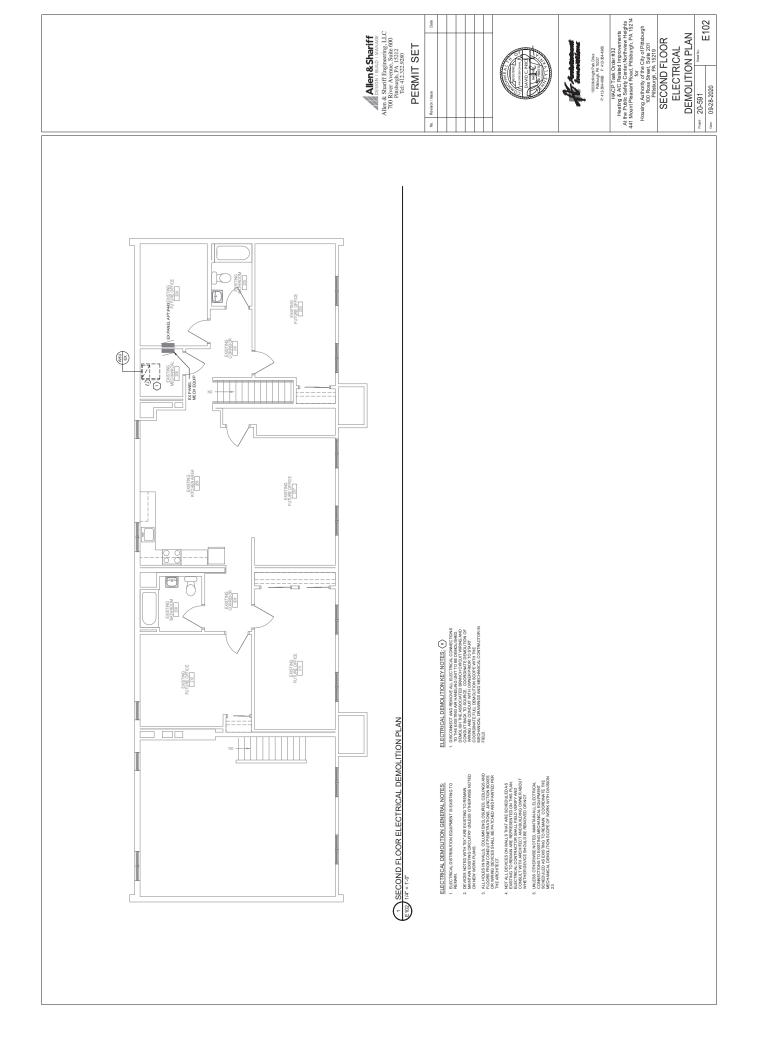


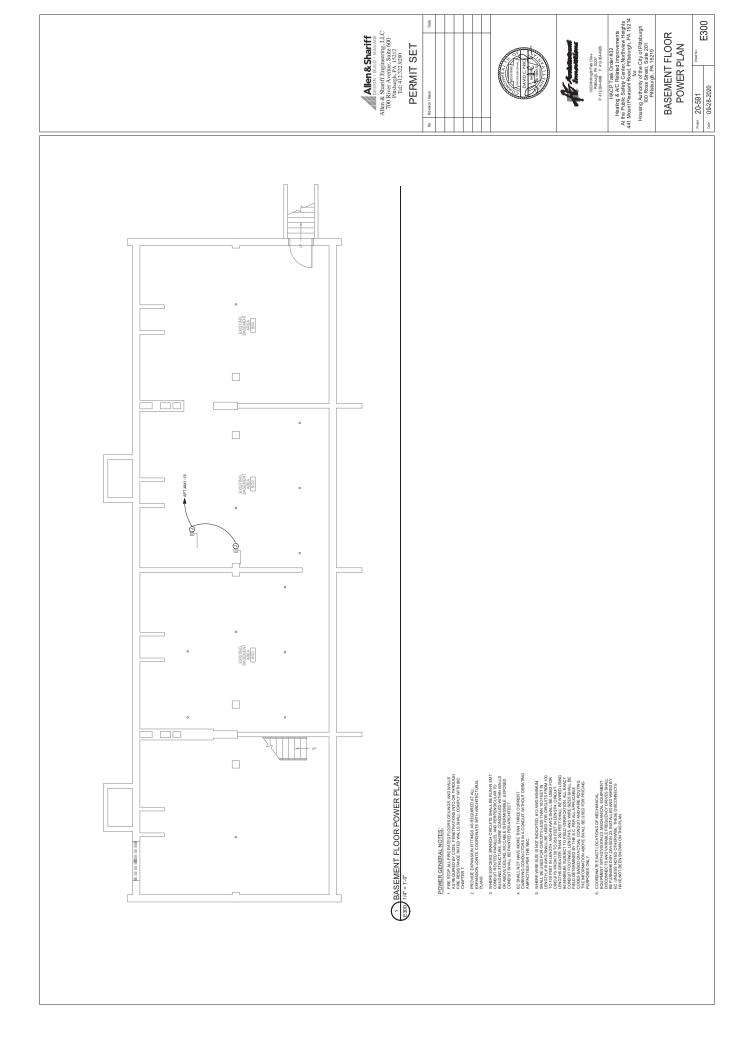
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| THERMAL INSUL | THERMAL INSULATION SCHEDULE | | | | | | | | | PIPE INSULAT | PIPE INSULATION THICKNESS SCHEDULE | SCHEDULE | | | | | Γ | No. Revision / Issue | | - |
| SVSTEM | SYSTEM - LOCATION | OPERATING TEMPERATURE | MATERIAL | TYPE | THICKNESS IN SI | SAMCNA CLASS BENSITY LBCUFT | INSTALLED "R" VALUE' CONDUCTIVITY | JACKET | REMARKS | FLUID OPERATING TEMPERATURE AND USAGE ("F) | AND CONDUCTION AND BTU-IN(P)(2,7E) | INSULATION CONDUCTIVITY DUCTIVITY IN(h:12."F) TEMPERATURE ("F) | | 1 to < 1 ¹ / ₂ | NOMINUL PIPE OR TUBE SIZE (IN) 1 to < 1 ¹ / ₂ < 4 to < 1 | ZE (IN) 4 to < 8 28 | | | | |
| DUCT | SUPPLY AIR DUCT - INDOOR CONCEALED, ACCESSIBLE | 40-120 | MINERAL-FIBER | BLANKET | 207 | 0.75 | 50 | ΒĶ | 1,6 | * 350 | 0.32 - 0.34 | | 4.5 | 6.0 | 95 | | | | | |
| DUCT | SUPPLY AIR DUCT - INDOOR CONCEALED, INACCESSIBLE | 40-120 | MINERAL-FIBER | BOARD | 1.5" | 2.25 | 6.5 | FSK | 2 | 251-350 | 0.29-0.32 | | 30 | 4.0 | 4.5 | _ | | | | |
| DUCT | SUPPLY AIR DUCT - INDOOR EXPOSED | 40-120 | UNINSULATED | | | | | | | 201-250 | 0.27-0.30 | | 25 | 2.5 | 25 | | _ | | | ß |
| DUCT | RETURN AIR DUCT - INDOOR EXPOSED | 40-120 | MINERAL-FIBER | CINED | 1.0" | 2.25 | 4.0 | | 2 | 141 - 200 | 0.25-029 | | 1.5 | 15 | 20 | | _ | | | Ŧ |
| DUCT | OUTSIDE AIR DUCT - NIDOOR | 0-100 | MINERAL-FIBER | BOARD | 25" | 2.25 | 80 | ž | ~ | 40 - 60 | 0.21-028 0.21-027 | 22 10 | 0.5 | 0.5 0.5 | 1.0 | 1.5 1.5 1.5 1.0 1.0 | | | | |
| DNIdid | REFRIGEART - CONDITIONED SPACE | 4060 | MINERAL-FIBER | PRE-MOLDED | | | | ASJ+SSL | 0 | 40 | 0.20-026 | 8 | 9.0 | 10 | 10 | 1.0 1.5 | | | | |
| UNID | SU VOS LURIVULI LIVIU III - LIVIU BERUISE VIII - LIVIU | 0505 | MINE RAL SIREE WICKING | _ | REFERTOP | REFER TO PIPING INSULATION THICKNESS | 1 THIOKNESS | 14501 | | REMARKS: PIP ING SERVING A (IECC 2015 TABLE | S PART OF A HEATING 2403.2.10) WITH THE R | OR COOLING SYSTEM S 2LLOWING EXCEPTIONS | HALL BE THERM | TLY INSULATED | IN ACCORDANCI | E WITH TABLE ABC | Æ | 7 | W.C. | 1 |
| SNIdid | COLD CONDENSATE DRA.N - INDORF, ONLY ON ME TAIL PIPE | 40.60 | MINERAL-FIBER | _ | | SCHEDULE | | ASJ+SSL | | 1. FACTORY-INST, BY THIS CODE. 2. FACTORY-INST/ THAT THE SAME | ALLED PIPING WITHIN - LLED PIPING WITHIN R | FINCTORVARSTALLED PPPMG WITHINHWAG EQUIPARENT TESTED AND RATED IN ACCORDANCE WITH A TEST PROCEDURE REFERENCED IN FINCTORE VISION INFORMATION AND AND AND AND AND AND AND AND AND AN | D AND RATED IN IT VENTILATORS | TESTED AND R | ATED ACCORDIN | DEDURE REFEREN 5 TO AHRI 330 (EX | CED | + | 1003 McKright Park Drive Pitsburch PA 15277 | hive g |
| DNIdId | OUTDOOR PIPING EXPOSED TO FREEZING (HEAT TRACED PIPE) | 40-100 | MINERAL-FIBER | PRE-MOLDED | | | | WILLA | | 3. PIPING THAT CO 4. PIPING THAT CO 5. STEAMERS CO | WUEYS FLUIDS THAT I NVEYS FLUIDS THAT I NVEYS FLUIDS THAT F | AVENDING OF SECTION AVE A DESIGN OPERAT. IAVE NOT BEEN HEATED | NG TEMPERATUR OR COOLED THE | E RANGE BETA OUGH THE USE | AU, RESPECTIVE EEN 60°F AND 10 OF FOSSIL FUEL SS IN DI AMETER | 5°F. S OR ELECTRIC P | WER. | P: 41 | 364-4966 F: 412 | 364-4955 |
| NOTES: OCONCEALED, ACC 1. CONCEALED, MAX 2. CONCEALED, INM, 3. FOR DUCTS ELOCA 4. CONSTRUCT PER, 5. DO NOT INSULATE - MADI EVON 18. DUCT INSULATE - RETURN AND EVON | HERE: - Concertain Accesses E countows - work unvior Accesses E Ecowed, a werts - concertain Accesses E countows - work who Accesses E Ecowed, a werts - concertain Accesses Economics - accesses E Ecowed, a werts - concertain Accesses - ac | L SHAFTS. AL SHAFTS. MASTIC ON ALL JONNES. INTE MASTIC ON ALL JONNES. INTE C PROTECT COMBUSTIBLE M | RAALLY LINE WITH ACOU | STICAL DUCT LINE R WITH FIRE RES | R. CROSS-BREA STANT INSULATI | (TOP TO SHED V 3N. | ATER. | _ |] | 6. DIRECT BURIER | PIPING THAT COME | S FLUIDS AT OR BELOW | 20.E | | | | | Heating & A/C Faskor Order #32 Heating & A/C Related Improvements After Public Starley Center Aborthriew Heagrits 441 Mount Pleasant Road, Pittsburgh, PA 15214 Housing Authority of the City of Pittsburgh Housing Authority Off Ross Street, Suite 201 100 Ross Street, Suite 201 | Heating & AC Related Improvements Heating & AC Related Improvements the Public Safety Center, Northview Heigh Mount Pleasant Road, Pittsburgh, PA 155 Housing Authority of the City of Pittsburgh Housing Authority of the City of Pittsburgh | r #32 nprovements lorthview Hei tsburgh, PA ty of Pittsbur life 201 |
| - TRANSFER AIR [- EXPOSED SUPPI 6. COVER AIL EXPC: 7. MULTIPLE INSULA 8. DUCTWORK SHALL | CITORONG KOLGALLEL VIE DUT LOTORING KONTELA VIE DUT KOLDINGKE KONTELA KEURDIN KOLDINGKE KONTELA KONTENDER SAALE (DOES NOT RALLIE ETURA RALLI SAALTINGDAW RELEBUT VO ARRIET INE DUAL REQUIRED PAALEET LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE SELECTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE PARTED MIERE TI RE PARTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE PARTED R LIE PAATED MIERE EPOSED ON VIERE TI IO OCCUPANTS COLOR TO RE PARTED R LIE PAATED R LIE P | un) ARCHITECT. | | | | | | | | | | | | | | | | ME SO | MECHANICAL SCHEDULES | CAL |
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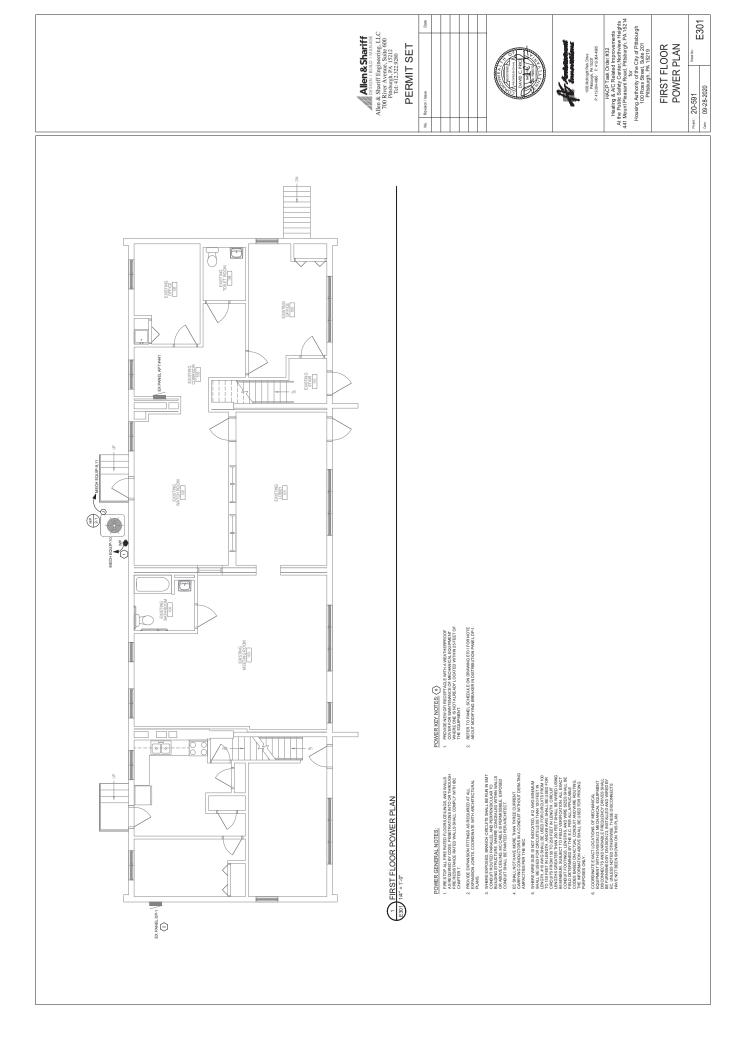
| | | | | | | | | | | n & Shariff | Allen & Shariff Engineering, LLC 700 River Avenue, Suite 600 Pittsburgh, PA 15212 Tel: 412.322.9280 | PERMIT SET | 0000 | | At an a | 1003 McKright Park Drive Problem of PA 5224 P. 412.944-4965 P. 412.944-4965 | HACP Task Order #32 Healing & A/C Related Improvements At the Public Safety Content Northwew Heights 441 Mount Pleasant Road, Pittsburgh, PA 16574 | for of the City of Pittsburgh treet, Suite 201 h, PA 15219 |
|-------------|---------------------------|-----------------------|--|--|-------------------------------|-----------------------|--|---|--|-------------|--|------------|------------------|--|---------|---|---|---|
| | | | | | | | | | | Alle | Allen & Sharifi 700 River A Pittsburg Tel: 41 | PERN | angei - I ne kau | | 4 | 1003 Mdr 1003 Mdr P 112 2034 449 | HACP Ta Heating & A/C R At the Public Safety (441 Mount Pleasant R | Housing Authority - 100 Ross 5 Pittsburg |
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| | REMARKS | | | | 2 | | | TOTAL FOR SECOND R. OOR | | | | | | | | | | |
| TOTAL REC'D | VENT@ AHU INLET (CFM) | 62 | 32.4 | 200 | NIA | 4.4 | 27.1 | 122.000 SE | | | | | | | | | | |
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| TOTAL REOD | VENT @ ROOM (CFM) | ω | 8 Ş | 2 Q | 35 | 4 | 8 8 | The Annual in 400 | | | | | | | | | | |
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| RATE | DIVERSITY | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | | | | | | | | | | | |
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| AREA RATE | RECYD VENT (CFM/SQFT) | 800 | 800 | 0.12 | 900 | 900 | 80 80 | TED FOR 2ND RLOOF | | | | | | | | | | |
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| | SPACE DESIGNATION | CORRIDOR | OFFICE | BRE AK ROOM | OFFICE | CORRIDOR | OFFICE | ED ON IMC.2015 SECTION | | | | | | | | | | |
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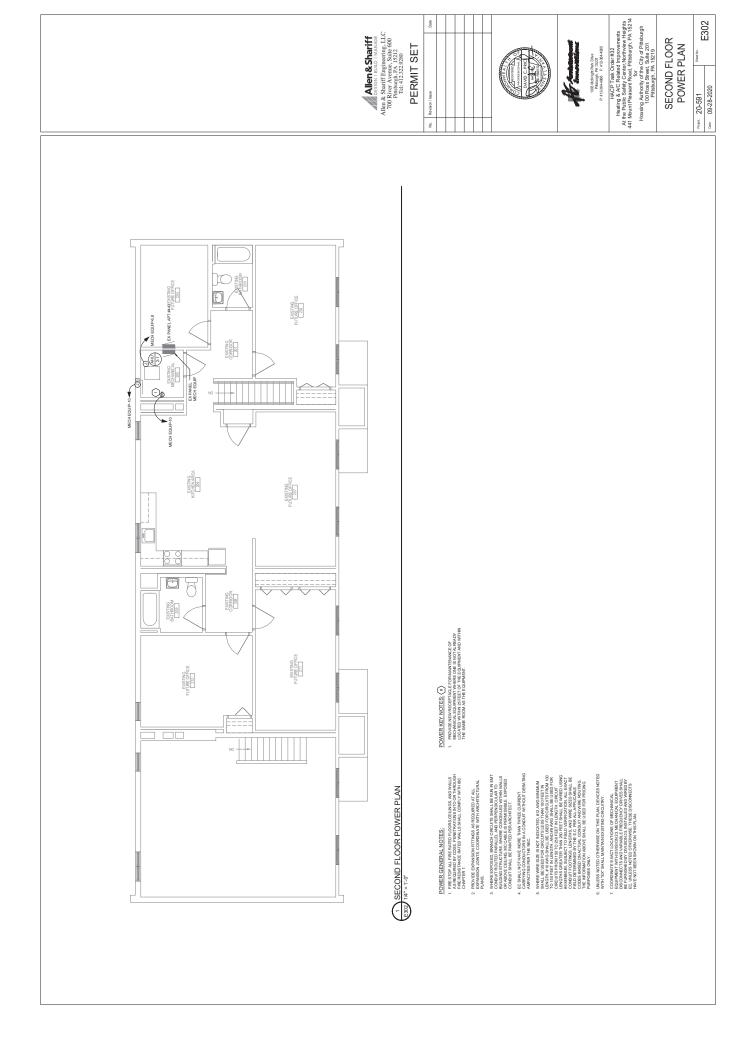
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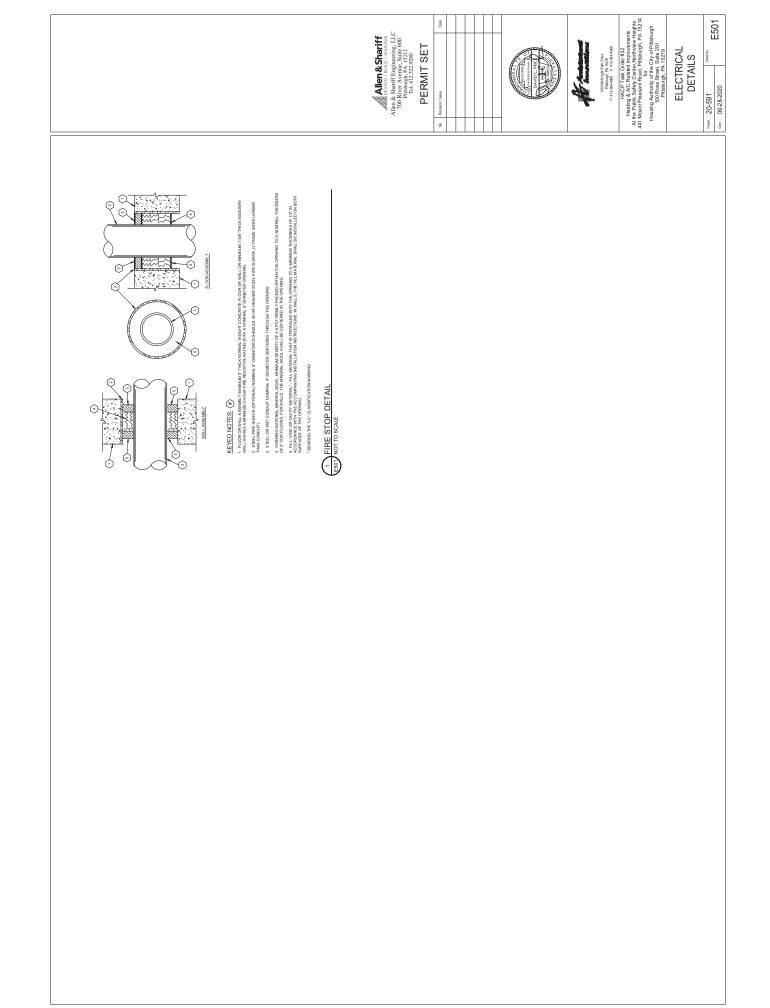


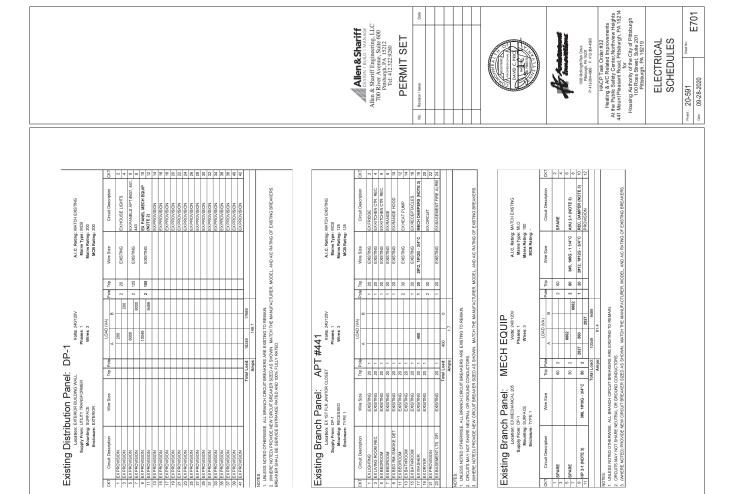












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