BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

REQUEST FOR PROPOSALS

Item Description: HVAC UPGRADES AT THE CITY CENTER ICE RINK

Date to be opened: NOVEMBER 8, 2021

Issuing Department: PARKS DEPARTMENT

QUESTIONS

- Please direct questions relative to the bidding process, how to fill out forms, and how to submit a bid (Pages 1-8) to Purchasing Agent Patti Jordan.
  - Phone: (401) 680-5264
  - Email: pjordan@providenceri.gov
    - Please use the subject line "**RFP Question**"
- Please direct questions relative to the Minority and Women's Business Enterprise Program and the corresponding forms (Pages 9-13) to the MBE/WBE Outreach Director for the City of Providence, Grace Diaz
  - Phone: (401) 680-5766
  - Email: gdiaz@providenceri.gov
    - Please use subject line "**MBE WBE Forms**"
- Please direct questions relative to the specifications outlined (beginning on page 14) to the issuing department's subject matter expert:
  - **BRIAN F. BYRNES – DEPUTY SUPERINTENDENT**
  - **(401) 660-9308**
  - **Bbyrnes@providenceri.gov**

Pre-bid Conference (Non-Mandatory)
Monday, October 18, 2021 at 9:00 AM – City Center Rink (On Site)

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

INSTRUCTIONS FOR SUBMISSION

Bids may be submitted up to **2:15 P.M.** on the above meeting date at the **Department of the City Clerk. Room 311, City Hall. 25 Dorrance Street, Providence.** At 2:15 P.M. all bids will be publicly opened and read at the Board of Contract Meeting in the City Council Chambers, on the 3rd floor of City Hall.

- Bidders must submit **2 copies** of their bid in sealed envelopes or packages labeled with the captioned **Item Description** and the **City Department to which the RFP and bid are related.** (On page 1)
- Communications to the Board of Contract and Supply that are not competitive sealed bids (i.e. product information/samples) should have "**NOT A BID**" written on the envelope or wrapper.
- Only use form versions and templates included in this RFP. If you have an old version of a form do not recycle it for use in this bid.
- The bid envelope and information relative to the bid must be addressed to:

Board of Contract and Supply
Department of the City Clerk – City Hall, Room 311
25 Dorrance Street
Providence, RI 02903

****PLEASE NOTE: This bid may include details regarding information that you will need to provide (such as proof of licenses) to the issuing department before the formalization of an award.**

This information is NOT requested to be provided in your initial bid by design.

All bids submitted to the City Clerk become public record. Failure to follow instructions could result in information considered private being posted to the city's Open Meetings Portal and made available as a public record. The City has made a conscious effort to avoid the posting of sensitive information on the City's Open Meetings Portal, by requesting that such sensitive information be submitted to the issuing department only at their request.

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID PACKAGE CHECKLIST

Digital forms are available in the City of Providence Purchasing Department Office or online at **http://www.providenceri.gov/purchasing/how-to-submit-a-bid/**

The bid package **MUST** include the following, in this order:

- Bid Form 1: Bidder's Blank as the cover page/ 1st page (*see page 6 of this document*)
- Bid Form 2: Certification of Bidder as 2nd page (*see page 7 of this document*)
- Bid Form 3: Certificate Regarding Public Records (*see page 8 of this document)*
- Forms from the Minority and Women Business Enterprise Program: Based on Bidder Category. *See forms and instructions enclosed (pages 9-13) or on: https://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/*

***Please note: MBE/WBE forms must be completed for EVERY bid submitted and must be inclusive of ALL required signatures. Forms without all required signatures will be considered incomplete.**

- Bidder's Proposal/Packet: Formal response to the specifications outlined in this RFP, including pricing information and details related to the good(s) or service(s) being provided. Please be mindful of formatting responses as requested to ensure clarity.
- Financial Assurance, *if requested* (*as indicated on page 5 of this document under "Bid Terms")*

All of the above listed documents are REQUIRED. (With the exception of financial assurances, which are only required if specified on page 5.)

******Failure to meet specified deadlines, follow specific submission instructions, or enclose all required documents with all applicable signatures will result in disqualification, or in an inability to appropriately evaluate bids.***

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

NOTICE TO VENDORS

1. The Board of Contract and Supply will make the award to the lowest qualified and responsible bidder.
2. In determining the lowest responsible bidder, cash discounts based on preferable payment terms will not be considered.
3. Where prices are the same, the Board of Contract and Supply reserves the right to award to one bidder, or to split the award.
4. No proposal will be accepted if the bid is made in collusion with any other bidder.
5. Bids may be submitted on an "equal in quality" basis. The City reserves the right to decide equality. Bidders must indicate brand or the make being offered and submit detailed specifications if other than brand requested.
6. A bidder who is an out-of-state corporation shall qualify or register to transact business in this State, in accordance with the Rhode Island Business Corporation Act, RIGL Sec. 7-1.2-1401, et seq.
7. The Board of Contract and Supply reserves the right to reject any and all bids.
8. Competing bids may be viewed in person at the Department of the City Clerk, City Hall, Providence, immediately upon the conclusion of the formal Board of Contract and Supply meeting during which the bids were unsealed/opened. Bids may also be accessed electronically on the internet via the City's Open Meetings Portal.
9. As the City of Providence is exempt from the payment of Federal Excise Taxes and Rhode Island Sales Tax, prices quoted are not to include these taxes.
10. In case of error in the extension of prices quoted, the unit price will govern.
11. The contractor will **NOT** be permitted to: a) assign or underlet the contract, or b) assign either legally or equitably any monies or any claim thereto without the previous written consent of the City Purchasing Director.
12. Delivery dates must be shown in the bid. If no delivery date is specified, it will be assumed that an immediate delivery from stock will be made.
13. A certificate of insurance will normally be required of a successful vendor.
14. For many contracts involving construction, alteration and/or repair work, State law provisions concerning payment of prevailing wage rates apply (RIGL Sec. 37-13-1 et seq.)
15. No goods should be delivered or work started without a Purchase Order.
16. **Submit 2 copies of the bid to the City Clerk, unless the specification section of this document indicates otherwise.**
17. Bidder must certify that it does not unlawfully discriminate on the basis of race, color, national origin, gender, gender identity or expression, sexual orientation and/or religion in its business and hiring practices and that all of its employees are lawfully employed under all applicable federal, state and local laws, rules and regulations. (See Bid Form 2.)

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID TERMS

1. Financial assurances may be required in order to be a successful bidder for Commodity or Construction and Service contracts. If either of the first two checkboxes below is checked, the specified assurance **must accompany** a bid, or the bid will not be considered by the Board of Contract and Supply. The third checkbox indicates the lowest responsible bidder will be contacted and required to post a bond to be awarded the contract.

   a) ☐ A certified check for $_____ must be deposited with the City Clerk as a guarantee that the Contract will be signed and delivered by the bidder.

   b) ☒ A bid bond in the amount of _____ per centum (%) of the proposed total price, must be deposited with the City Clerk as a guarantee that the contract will be signed and delivered by the bidder; and the amount of such bid bond shall be retained for the use of the City as liquidated damages in case of default.

   c) ☒ A performance and payment bond with a satisfactory surety company will be posted by the bidder in a sum equal to one hundred per centum (100%) of the awarded contract.

   d) ☐ No financial assurance is necessary for this item.

2. Awards will be made within **sixty (60) days of bid opening**. All bid prices will be considered firm, unless qualified otherwise. Requests for price increases will not be honored.
3. Failure to deliver within the time quoted or failure to meet specifications may result in default in accordance with the general specifications. It is agreed that deliveries and/or completion are subject to strikes, lockouts, accidents and Acts of God.

The following entry applies only for COMMODITY BID TERMS:

4. Payment for partial delivery will not be allowed except when provided for in blanket or term contracts.

The following entries apply only for CONSTRUCTION AND SERVICE BID TERMS:

5. Only one shipping charge will be applied in the event of partial deliveries for blanket or term contracts.
6. Prior to commencing performance under the contract, the successful bidder shall attest to compliance with the provisions of the Rhode Island Worker's Compensation Act, RIGL 28-29-1, et seq. If exempt from compliance, the successful bidder shall submit a sworn Affidavit by a corporate officer to that effect, which shall accompany the signed contract.
7. Prior to commencing performance under the contract, the successful bidder shall, submit a certificate of insurance, in a form and in an amount satisfactory to the City.

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BID FORM 1: Bidders Blank

1. Bids must meet the attached specifications. Any exceptions or modifications must be noted and fully explained.
2. Bidder's responses must be in ink or typewritten, and all blanks on the bid form should be completed.
3. The price or prices proposed should be stated both in **WRITING** and in **FIGURES**, and any proposal not so stated may be rejected. **Contracts exceeding twelve months must specify annual costs for each year.**
4. Bids **SHOULD BE TOTALED** so that the final cost is clearly stated (unless submitting a unit price bid), however **each item should be priced individually**. Do not group items. Awards may be made on the basis of ***total*** bid or by ***individual items***.
5. All bids **MUST BE SIGNED IN INK.**

Name of Bidder (Firm or Individual): _____

Contact Name: _____

Business Address: _____

Business Phone #: _____

Contact Email Address: _____

Agrees to bid on (Write the "Item Description" here): _____

If the bidder's company is based in a state *other than Rhode Island*, list name and contact information for a local agent for service of process that ***is located within Rhode Island*** _____

Delivery Date (if applicable): _____

Name of Surety Company (if applicable): _____

Total Amount in Writing*: _____

Total Amount in Figures*: _____

** If you are submitting a unit price bid, please insert "Unit Price Bid"*

Use additional pages if necessary for additional bidding details.

_____

Signature of Representation

_____

Title

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 2: Certification of Bidder
(Non-Discrimination/Hiring)

Upon behalf of_____(Firm or Individual Bidding),

I,_____(Name of Person Making Certification),

being its_____(Title or "Self"), hereby certify that:

1. Bidder does not unlawfully discriminate on the basis of race, color, national origin, gender, sexual orientation and/or religion in its business and hiring practices.
2. All of Bidder's employees have been hired in compliance with all applicable federal, state and local laws, rules and regulations.

I affirm by signing below that I am duly authorized on behalf of Bidder, on this_____day of_____20____.

_____
Signature of Representation

_____
Printed Name

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 3: Certificate Regarding Public Records

Upon behalf of_____(Firm or Individual Bidding),

I,_____(Name of Person Making Certification),

being its_____(Title or "Self"), hereby certify an understanding that:

1. All bids submitted in response to Requests for Proposals (RFP's) and Requests for Qualification (RFQ's), documents contained within, and the details outlined on those documents become public record upon receipt by the City Clerk's office and opening at the corresponding Board of Contract and Supply (BOCS) meeting.
2. The Purchasing Department and the issuing department for this RFP/RFQ have made a conscious effort to request that sensitive/personal information be submitted directly to the issuing department and only at request if verification of specific details is critical the evaluation of a vendor's bid.
3. The requested supplemental information may be crucial to evaluating bids. Failure to provide such details may result in disqualification, or an inability to appropriately evaluate bids.
4. If sensitive information that has not been requested is enclosed or if a bidder opts to enclose the defined supplemental information prior to the issuing department's request in the bidding packet submitted to the City Clerk, the City of Providence has no obligation to redact those details and bears no liability associated with the information becoming public record.
5. The City of Providence observes a public and transparent bidding process. Information required in the bidding packet may not be submitted directly to the issuing department at the discretion of the bidder in order to protect other information, such as pricing terms, from becoming public. Bidders who make such an attempt will be disqualified.

I affirm by signing below that I am duly authorized on behalf of Bidder, on this_____day of_____20____.

_____
Signature of Representation

_____
Printed Name

WBE/MBE Form Instructions

The City of Providence actively seeks Minority and Women business enterprises to participate in bids to meet the City's procurement needs. Pursuant to the City of Providence Code of Ordinances, Chapter 21, Article II, Sec. 21-52 (Minority and Women's Business Enterprise) and Rhode Island General Laws (as amended), Chapter 31-14, et seq. (Minority Business Enterprise), Minority Business Enterprise (MBE) and Women's Business Enterprise (WBE) participation goals apply to contracts.

The goal for Minority Business Enterprise (MBE) participation is **10%** of the total bid value.
The goal for Women's Business Enterprise (WBE) participation is **10%** of the total bid value.
The goal for combined MBE/WBE participation is **20%** of the total bid value.

Only businesses certified with the State of Rhode Island as minority and/or women business enterprises are counted towards the City's goals. Eligible minority or women-owned businesses are encouraged to seek certification from the State of Rhode Island Minority Business Enterprise Compliance Office at: http://odeo.ri.gov/offices/mbeco/

Note: MBE certification with the State of Rhode Island on the basis of Portuguese heritage is not currently recognized by the City of Providence's MBE program.

Bid Requirements:

All Bidders: All bidders must complete and submit the ***MBE/WBE Participation Affidavit*** indicating whether or not they are a state-certified MBE/WBE and acknowledging the City's participation goals. Submission of this form is required with **every bid**. Your bid will not be accepted without an affidavit.

Bidders who will be subcontracting: Bidders who will be subcontracting must submit the ***Subcontractor Disclosure Form*** as part of their bid submission. All subcontractors, regardless of MBE/WBE status, must be listed on this form. Business NAICS codes can be found at https://www.naics.com/search/. Awarded bidders are required to submit ***Subcontractor Utilization and Payment Reports*** with each invoice.

Waiver Requests:

If the percentage of the total amount of the bid being awarded to MBE or WBE vendors is less than 20% (Box F on the Subcontractor Disclosure Form) and the prime contractor is not a Rhode Island State-certified MBE or WBE, the Bidder must complete the *MBE/WBE Waiver Request Form* for review. Waivers will be considered on a case by case basis.

No waiver will be granted unless the waiver request includes documentation that demonstrates that the Bidder has made good faith efforts to achieve the City's stated participation goals. Waivers must be reviewed and signed by the City of Providence's MBE/WBE Outreach Director, Grace Diaz, or her designee. Department Directors cannot recommend a bidder for award if this form is applicable and absent. If the bid does not meet the participation goals of the City of Providence and a waiver is not filed with the signature of the MBE/WBE Outreach Director or her designee, the bid will not be accepted.

Verifying MBE/WBE Certification

It is the responsibility of the bidder to confirm that every MBE/WBE named in a proposal and included in a contract is certified by the Rhode Island Minority Business Enterprise Compliance office. The current MBE/WBE directory is available at the State of RI MBE Office, One Capitol Hill, 2nd Floor, Providence, RI, or online at http://odeo.ri.gov/offices/mbeco/mbe-wbe.php. You can also call (401) 574-8670 to verify certification, expiration dates, and services that the MBE/WBE is certified to provide. Note: MBE certification with the State of Rhode Island on the basis of Portuguese heritage is not currently recognized by the City of Providence's MBE program.

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Form Instructions:

Access all bid forms from http://www.providenceri.gov/oeo/ or http://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/. **Download** the forms as blank PDFs. Once saved on your computer, fill them out using the Adobe program. The fillable PDFs must be completed in Adobe in order to be saved property. Google Chrome and similar platforms do not allow for the forms to be saved as filled PDFs. Therefore, please download the blank forms to your computer, then fill them out and save.

Assistance with Form Requirements

Examples of completed forms can be found on the City of Providence website at http://www.providenceri.gov/oeo/ or http://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/.

Contract Requirements:

Prime contractors engaging subcontractors must submit the ***Subcontractor Utilization and Payment Report*** to the City Department's Fiscal Agent with every invoice and with request for final payment. This form is not submitted as a part of the initial bid package.

For contracts with duration of less than 3 months, this form must be submitted along with the contractor's request for final payment. The form must include all subcontractors utilized on the contract, both MBE/WBE and non- MBE/WBE, the total amount paid to each subcontractor for the given period and to date. During the term of the contract, any unjustified failure to comply with the MBE/WBE participation requirements is a material breach of contract.

Questions?

For more information or for assistance with MBE/WBE Forms, contact the City of Providence MBE/WBE Outreach Director, Grace Diaz, at mbe-wbe@providenceri.com or (401) 680-5766.

BOARD OF CONTRACT AND SUPPLY

CITY OF PROVIDENCE, RHODE ISLAND

MBE/WBE PARTICIPATION AFFIDAVIT

Item Discussion (as seen on RFP):

_____

_____

_____

Prime Bidder: _____

Prime Bidder (Company) Phone Number:_____

Which one of the following describes your business' status in terms of Minority and/or Woman-Owned Business Enterprise certification with the State of Rhode Island? _____MBE _____WBE _____Neither MBE nor WBE

By initialing the following sections and signing the bottom of this document in my capacity as the contractor or an authorized representative of contractor, I make this Affidavit:

It is the policy of the City of Providence that minority business enterprises (MBEs) and women business enterprises (WBEs) should have the maximum opportunity to participate in procurements and projects as prime contractors and vendors. Pursuant to Sec. 21-52 of the Providence Code of Ordinances and Chapter 31-14 *et seq.* of the Rhode Island General Laws (as amended), MBE and WBE participation goals apply to contracts.

The goal for Minority Business Enterprise (MBE) participation is 10% of the total bid value.
The goal for Women's Business Enterprise (WBE) participation is 10% of the total bid value.
The goal for combined MBE/WBE participation is 20% of the total bid value.

I acknowledge the City of Providence's goals of supporting MBE/WBE certified businesses. Initial _____

If awarded the contract, I understand that my company must submit to the Minority and Women's Business Coordinator at the City of Providence (MBE/WBE Office), copies of all executed agreements with the subcontractor(s) being utilized to achieve the participation goals and other requirements of the RI General Laws. **I understand that these documents must be submitted prior to the issuance of a notice to proceed.** Initial _____

I understand that, if awarded the contract, my firm must submit to the MBE/WBE Office canceled checks and reports required by the MBE/WBE Office on a quarterly basis verifying payments to the subcontractors(s) utilized on the contract.
Initial _____

If I am awarded this contract and find that I am unable to utilize the subcontractor(s) identified in my Statement of Intent, I understand that I must substitute another certified MBE and WBE firm(s) to meet the participation goals. **I understand that I may not make a substitution until I have obtained the written approval of the MBE/WBE Office.**
Initial _____

If awarded this contract, I understand that authorized representatives of the City of Providence may examine the books, records and files of my firm from time to time, to the extent that such material is relevant to a determination of whether my firm is complying with the City's MBE/WBE participation requirements.
Initial _____

I do solemnly declare and affirm under the penalty of perjury that the contents of the foregoing Affidavit are true and correct to the best of my knowledge, information and belief.

_____ _____
Signature of Bidder Printed Name

_____ _____
Company Name Date

BOARD OF CONTRACT AND SUPPLY

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SUBCONTRACTOR DISCLOSURE FORM

Fill out this form only if you WILL SUBCONTRACT with other parties. If you will not subcontract any portion of the proposed bid, do not fill out this form.

Prime Bidder: _____ Primary NAICS Code: _____

Item Description (as seen on RFP): _____

_____

Please list all Subcontractors below. Include the total dollar value that you propose to share with each subcontractor and the dollar amount to be subcontracted. Please check off MBE and WBE where applicable. The directory of all state-certified MBE/WBE firms is located at www.mbe.ri.gov. Business NAICS codes can be found at https://www.naics.com/search/

Proposed Subcontractor	MBE	WBE	Primary NAICS Code	Date of Mobilization	$ Value of Subcontract
					$
					$
					$
					$
					$
					$
A. MBE SUBCONTRACTED AMOUNT:					$
B. WBE SUBCONTRACTED AMOUNT:					$
C. NON MBE WBE SUBCONTRACTED AMOUNT:					$
D. DOLLAR AMOUNT OF WORK DONE BY THE PRIME CONTRACTOR:					$
E. TOTAL AMOUNT OF BID (SUM OF A, B, C, & D):					$
F. PERCENTAGE OF BID SUBCONTRACTED TO MBEs AND WBEs. (Divide the sum of A and B by E and multiply result by 100).					%

Please read and initial the following statement acknowledging you understand. If the percentage of the total amount of the bid being awarded to MBE or WBE vendors is less than 20% (Box F) and the prime contractor is NOT a Rhode Island State-certified MBE or WBE, **you must fill out the MBE/WBE WAIVER REQUEST FORM for consideration by City of Providence MBE/WBE Outreach Director**. Initial _____

_____ _____

Signature of Bidder Printed Name

BOARD OF CONTRACT AND SUPPLY
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MBE/WBE Waiver Request Form

Fill out this form only if you are subcontracting and did not meet the 20% MBE/WBE participation goal.
State-certified MBE or WBE Prime Bidders are NOT REQUIRED to fill out this form.

Submit this form to the City of Providence MBE/WBE Outreach Director, Grace Diaz, at mbe-wbe@providenceri.gov, for review **prior to bid submission.** This waiver applies only to the current bid which you are submitting to the City of Providence and does not apply to other bids your company may submit in the future.

Prime Bidder: _____
Company Trade: _____
Item Discussion (as seen on RFP):
_____

To receive a waiver, you must list the certified MBE and/or WBE companies you contacted, the name of the primary individual with whom you interacted, and the reason the MBE/WBE company could not participate on this project.

MBE/WBE Company Name	Individual's Name	Company Trade	Why did you choose not to work with this company?

I acknowledge the City of Providence's goal of a combined MBE/WBE participation is 20% of the total bid value. I am requesting a waiver of _____ % MBE/WBE (20% minus the value of **Box F** on the Subcontractor Disclosure Form). If an opportunity is identified to subcontract any task associated with the fulfillment of this contract, a good faith effort will be made to select MBE/WBE certified businesses as partners.

Signature of Prime Contractor	Printed Name	Date Signed
Signature of City of Providence MBE/WBE Outreach Director	Printed Name of City of Providence MBE/WBE Outreach Director	Date Signed

BOARD OF CONTRACT AND SUPPLY
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SUPPLEMENTAL INFORMATION

If the issuing department for this RFP determines that your firm's bid is best suited to accommodate their need, you will be asked to provide proof of the following prior to formalizing an award.

An inability to provide the outlined items at the request of the department may lead to the disqualification of your bid.

This information is NOT requested to be provided in your initial bid that you will submit to the City Clerk's office by the "date to be opened" noted on page 1. This list only serves as a list of items that your firm should be ready to provide on request.

All bids submitted to the City Clerk become public record. Failure to follow instructions could result in information considered private being posted to the city's Open Meetings Portal and made available as a public record.

You must be able to provide:

- Business Tax ID will be requested after an award is approved by the Board of Contract and Supply.
- Proof of Insurance

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

BID FORM 3: Supplemental Bid Form

To whom it may concern:

1. The undersigned, having familiarized (himself) (themselves) (itself) with the **HVAC Upgrades at the City Center Ice Rink** bid affecting the cost of work, and with the Contract Documents (which includes the Invitation for Bids, Instructions to Bidders, Form of Bid Bond, Form of Agreements, form of Non-Collusive Affidavit, Addenda (if any), Drawings, Technical Specification, Form of Surety Bond(s); as prepared by the Providence Parks Department, and on file in the office of the City Clerk 3rd Floor, City Hall, Providence, RI 02903, hereby proposes to furnish all supervision, technical personnel, labor, materials, machinery, tools, equipment and services including utility and transportation services, and to perform such other required work for the **HVAC Upgrades at the City Center Ice Rink** and such other required and incidental work, complete, all in accordance with the above listed documents and for the unit prices for work in-place for the following items and quantities.

2. In submitting this Bid, the bidder understands that the right is reserved by The Providence Parks Department to reject any and all Bids, If written notice of acceptance of this Bid is mailed, telegraphed or delivered to the undersigned within (90) days after the opening thereof, or at any time thereafter before this Bid is withdrawn, the undersigned agrees to execute and deliver an Agreement in the prescribed form and furnish the required bond within (10) days after the Agreement is presented to him/her for signature.

Herewith in accordance with the instructions to Bidders.

3. Attached hereto is an affidavit in proof that the undersigned has not colluded with any person in respect to this. Bid or any bids for the Contractor for which this Bid is submitted. Also attached is a Statement of Bidder's Qualifications.

4. Application unit prices are contained in the Agreement (established as the result of either a Unit Price Bid or a Supplemental Schedule of Unit Prices), the City of Providence may order the Contractor to proceed with desired changes in the work, the value of such changes to be determined by the measured quantities involved and the application unit prices specified in the Contract.

5. The City of Providence reserves the right to determine the lowest responsible Bidder based on past experience with the City and/or recommendations by City and/or state agencies with an interest in this procurement. The City reserves the right to award the project to the appropriate bidder in the best interest of the City of Providence.

CERTIFICATION OF NON-SEGREGATED FACILITIES

The Bidder certifies that he/she does not maintain or provide for his/her employees any segregated facilities at any of his establishments, and that he/she does not permit his/her employees to perform their services at any location, under his/her control, where segregation facilities are maintained. The Bidder agrees that a breach of this certification will be a violation of the Equal Opportunity Clause in any contract resulting from acceptance of this Bid. As used in this certification, term "segregation facilities" means any waiting rooms, work rooms, 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 employee which are segregated by explicit directive or are in fact segregated on basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. The Bidder agrees that (except where he/she has obtained identical certification from proposed subcontractors for specific time periods) he/she will obtain identical certification from proposed subcontractor prior to the award of subcontracts exceeding $10,000.00 which are not exempt from provisions of the Equal Opportunity Clause, and that he /she will retain such certifications in his/her files.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. & 1001.

DATE _____, **20**___

Name of Bidder and Official Address:

Name of Authorized Representative (Contact):

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

_____ _____

_____ By _____
(Signature)

_____ Title _____

E-Mail: _____ Phone: _____

Bidder shall indicate, in space provided,
the earliest possible Project Start-up Date: _____, 20 ____

ADDENDA: The undersigned acknowledges receipt of the following Addenda, if any, and has included the provisions thereof in this Bid (If Any):

Addendum No.	Date	Addendum No.	Date
_____	_____, 20 ____	_____	_____, 20 ____
_____	_____, 20 ____	_____	_____, 20 ____

Sub-Contractors (If Any):

Name: _____ **Scope of Work:** _____ **MBE / WBE**

Name: _____ **Scope of Work:** _____ **MBE / WBE**

Name: _____ **Scope of Work:** _____ **MBE / WBE**

BOARD OF CONTRACT AND SUPPLY
CITY OF PROVIDENCE, RHODE ISLAND

SUPPLEMENTAL BID FORM

HVAC UPGRADES AT THE CITY CENTER ICE RINK

BASE BID:

The scope of work for the Base Bid requested in the following RFP shall include but not be limited to the removal of the existing HVAC components in the City Center Ice Rink Skate Room and the upgrade/installation of a fully functioning HVAC system with supplemental heating and hot water system for the zamboni. Under this contract the vendor shall completely remove all of the existing HVAC equipment abandoned (and no longer required) in this new installation, per the plans and specifications.

This vendor shall supply and install all components for the system as depicted in the plans and specification including the upgrade/installation of the electrical service to power the new system.

In addition to stating the Total Base Bid, The bidder shall state Unit Prices for related work listed under each bid item which represents the work items included in the Total Base Bid. The Unit Prices are quoted for computing adjustments to the Base Bid prior to Contract award, as well as during the course of construction, based upon extra work ordered by the City or for work countermanded, reduced or omitted by the City in order to stay within the Project budget.

Base Bid Items and Unit prices are to be Completed prices to be added or deducted on the basis of quantities of work involved, for each item in place in the unit indicated.

BASE BID: Complete and functioning HVAC system for the skate room and hot water supply for the Zamboni.

All Work Included in this Project Shall be Completed for the lump sum of:

_____ **Dollars**

($_____), TOTAL BASE BID

ALTERNATES:

1. **Temporary Heat and Hot Water Supply (During Construction)**

_____ **LS** **$_____**

price in writing

UNIT PRICES:

1. **Hourly Rates for all trades and work classifications shall be provided in a bid supplement**

BIDDER: _____

Please note that the list above is not intended to include all items required to complete the base bid scope of work but can and shall be used to adjust the contract prior to or after award – in the best interest of the City of Providence.

BID DOCUMENTS:

The complete set of Bid Documents consists of the Bid Form, Technical Specifications, Minority Participation Forms, and the following Drawings:

DRAWINGS:

- G-000 PROJECT COVER SHEET
- A-101 ARCHITECTURAL PLANS
- M-000 MECHANICAL COVER SHEET
- M-101 MECHANICAL PLANS
- E-000 ELECTRICAL COVER SHEET
- E-101 ELECTRICAL PLANS

TECHNICAL SPECIFICATION:

- DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS
- DIVISION 01 GENERAL REQUIREMENTS
- DIVISION 22 PLUMBING
- DIVISION 23 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
- DIVISION 26 ELECTRICAL

ADDITIONAL INFORMATION REQUIRED WITH BID:

- Qualifications to Perform Work – See Form Below for Information Required
- Minority Participation Forms – 10% MBE / 10 % WBE Goal on this Project
- Addenda (If Any) - Must Be Acknowledged on Bid Form
- Product Information for Items Submitted as 'Or Equal' to Specified Materials

PROVISIONS OF THIS PROJECT:

- Upon the Issuance of the Award from the Board of Contract – the City shall issue a Contract to be executed by the City and the vendor incorporating the bid specifications. All Provisions of the Specifications are binding.
- Any Permits Required by the City of Providence and/or State of Rhode Island Shall be Obtained by the Vendor – Permit Fees by the City of Providence Shall be Waived – the State ADA Fee Must be Paid
- The Davis Bacon Act Applies (HUD Projects) – Prevailing Wages Must Be Paid for On Site Hours – On-Site Interviews will be Conducted During the Project – Employees Shall be Advised of the Prevailing Wage Rates Prior to Mobilization on Site
- Certified payrolls Must be Submitted With Pay Requests Including Monthly Utilizations Form
- Performance and Payment Bonds (If Required) Must be Submitted within 10 Days of Award or Bid Bond Will be Forfeited
- An Insurance Certificate Shall be Submitted to the City Within 10 Days of Award

- A Copy of the Vendors Contractor's License Must be Submitted within 10 Days of Award
- All On-Site Personnel Shall be Licensed (If Required) and Shall have Proof of All Licenses Required by the State of Rhode Island to Perform the Work Required
- Pay Requests Must be Submitted on Approved AIA Billing Documents (City will Provide if Needed)
- All Subcontractors Shall be Listed on the Bid Form – All Insurance & Payroll Requirements Apply
    - General Contractor Shall be the Insurance Certificate Holder and the City Shall be Named as 'Additionally Insured' with Respect to Liability Insurance
- A Submittal Log Must be Submitted within 10 Days of Award

CLOSE OUT DOCUMENTS:

- Prior to Final Payment the Vendor Shall Provide the Following:
    - Copies of Permits Signed off and Approved (If Any)
    - Operating Manuals and Warranties Shall Be Transferred and/or Delivered
    - Full and Completed As-Built Drawings Shall be Submitted for Approval
    - Training Shall be Provided to City Personnel (If Required)
    - Certification by Manufactures Representative (If Required)

QUALIFICATIONS:

Qualifications will be evaluated on the basis of similar project experience for:

a. Completion of at least 3 similar projects within the past five years.
b. Size and dollar value of similar completed projects.
c. Contractor's performance with similar projects. (references will be checked)
d.. Relevant experience of individuals assigned to the project.

Questions regarding this bid package shall be submitted via e-mail to **Patti Jordan** at pjordan@providenceri.gov and **Brian Byrnes, Deputy Superintendent of Parks** at bbyrnes@providenceri.gov , no later than five (5) working days before the bid opening date.

Brian Byrnes is the project contact and can be reached at 401-660-9308.

SECTION 00 01 10

TABLE OF CONTENTS

END OF SECTION

SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Ice Rink HVAC Upgrades.

B. Owner's Name: Rethinking Power Management, LLC.

C. Architect's Name: Studio JAED.

D. The Project consists of the construction of _____.

1.02 CONTRACT DESCRIPTION

1.03 DESCRIPTION OF ALTERATIONS WORK

A. HVAC: Alter existing system and add new construction, keeping existing in operation.

B. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

1.04 WORK BY OWNER

A. Owner will supply and install the following:

B. Owner will supply the following for installation by Contractor:

1.05 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a separate transmittal for each item.

3.02 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

D. Architect's and consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Approved", or language with same legal meaning.
      b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
         1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
      c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
   2. Not Authorizing fabrication, delivery, and installation:

E. Architect's and consultants' actions on items submitted for information:
   1. Items for which no action was taken:
      a. "Received" - to notify the Contractor that the submittal has been received for record only.
   2. Items for which action was taken:
      a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

J. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

K. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

L. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.

M. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

N. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

O. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

P. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

R. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

S. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.

T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Samples: Submit two samples of any representative size illustrating each insulation type.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience, or and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. CertainTeed Corporation; : www.certainteed.com.
   5. Substitutions: See Gilbane Project Manual.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum service temperature: 850 degrees F; 1200 degrees F; 1600 degrees F.
   3. Maximum moisture absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 ; semi-rigid, noncombustible, end grain adhered to jacket.
   1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum service temperature: 650 degrees F.
   3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive:
   1. Compatible with insulation.

G. Insulating Cement/Mastic:

1. ASTM C195; hydraulic setting on mineral wool.

H. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 lb/cu ft density.
3. Weave: 5x5; 10x10; or 10x20.

I. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, black or white color.

J. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Outdoor Breather Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

L. Insulating Cement:
1. ASTM C449/C449M.

2.03 CELLULAR GLASS

A. Manufacturers:
1. Pittsburgh Corning Corporation: www.foamglasinsulation.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C552, Grade 1.
1. 'K' value: 0.37 at 100 degrees F.
2. Service Temperature: Up to 900 degrees F.
3. Water Vapor Permeability: 0.005 perm inch.
4. Water Absorption: 0.2 percent by volume, maximum.

2.04 EXPANDED POLYSTYRENE

A. Manufacturers:

B. Insulation: ASTM C578; rigid closed cell.
1. 'K' value: 0.23 at 75 degrees F.
2. Maximum service temperature: 165 degrees F.
3. Maximum water vapor permeance: 5.0 perms

2.05 EXPANDED PERLITE

A. Manufacturers:
1. Schundler Company: www.schundler.com/#sle.

B. Insulation: ASTM C610, molded.
1. Maximum service temperature: 1200 degrees F.
2. Maximum water vapor transmission: 0.1 perm.

2.06 POLYISOCYANURATE CELLULAR PLASTIC

A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. Dimension: Comply with requirements of ASTM C585.
2. 'K' value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
3. Minimum Service Temperature: -70 degrees F.
4. Maximum Service Temperature: 300 degrees F.
5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842..
6. Moisture Vapor Transmission: 4.0 perm in.
7. Connection: Waterproof vapor barrier adhesive.

2.07 POLYETHYLENE

A. Manufacturers:
   1. Armacell International: www.armacell.com/#sle.

B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
   1. 'K' value: ASTM C177; 0.25 at 75 degrees F.
   2. Maximum Service Temperature: 200 degrees F.
   3. Density: 2 lb/cu ft.
   4. Maximum Moisture Absorption: 1.0 percent by volume.
   5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
   6. Connection: Contact adhesive.

2.08 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Armacell International: www.armacell.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3;grade 2; grade 1 use molded tubular material wherever possible.
   1. Minimum Service Temperature: -40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.09 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation: www.jm.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 20 mil; 30 mil.
      e. Connections: Brush on welding adhesive, tacks, pressure sensitive color matching vinyl tape.
   3. Covering Adhesive Mastic:

B. ABS Plastic:
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: -40 degrees F.
      b. Maximum Service Temperature of 180 degrees F.
      c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 30 mil.
      e. Connections: Brush on welding adhesive.

C. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   1. Lagging Adhesive:

a. Compatible with insulation.

D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch, 0.020 inch sheet.
2. Finish: Smooth, embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

E. Stainless Steel Jacket: ASTM A 666, Type 304 or 316 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

3.04 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic hot, recirculated hot water.
   1. Operating Temperature: 60 to 140 deg F.
   2. Insulation Material: Flexible elastomeric or glass fiber.
   3. Insulation Thickness: Apply the following insulation thicknesses:
      a. Pipe, All Sizes: 1.0 inch.
   4. Jacket:
      a. Exposed Spaces (mechanical rooms, closets, etc.) = PVC
      b. Concealed Spaces = None
   5. Vapor Retarder Required: No.
   6. Finish: None.

B. Service: Domestic cold water.
   1. Operating Temperature: 35 to 60 deg F.
   2. Insulation Material: Flexible elastomeric or glass fiber.
   3. Insulation Thickness: Apply the following insulation thicknesses:
      a. Pipe, 1" or less: 0.5 inch.
      b. Pipe, 1¼" to 2" : 0.5 inch.
      c. Pipe, 2-1/2" to 4": 1.0 inch.
      d. Pipe, 5" and up : 1.0 inch.
   4. Jacket:
      a. Exposed Spaces (mechanical rooms, closets, etc.) = PVC
      b. Concealed Spaces = None
   5. Vapor Retarder Required: Yes.
   6. Finish: None.

C. Service: Rainwater conductors.
   1. Operating Temperature: 32 to 100 deg F.
   2. Insulation Material: Mineral fiber.
   3. Insulation Thickness: Apply the following insulation thicknesses:
      a. Pipe, 3" and up: 1.0 inch.

4. Jacket:
   a. Concealed Piping - None
   b. Exposed Piping - PVC
5. Vapor Retarder Required: Yes.
6. Finish: None.

D. Service: Roof drain bodies.
1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: 1.0 inch.
4. Jacket:
   a. Concealed - None
   b. Exposed - PVC
5. Vapor Retarder Required: Yes.
6. Finish: None

E. Service: Sanitary waste piping where heat tracing is installed.
1. Operating Temperature: 35 to 100 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:
   a. Pipe, 3" and up: 1.0 inch.
4. Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

F. Service: Condensate drain piping.
1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: 0.5 inch.
4. Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

G. Service: Exposed sanitary drains and domestic water supplies and stops for fixtures for the disabled.
1. Operating Temperature: 35 to 120 deg F.
2. Insulation Material: Molded closed cell vinyl.
3. Insulation Thickness: 3/16 inch.
4. Vapor Retarder Required: No.
5. Finish: None.

3.05 EXTERIOR INSULATION APPLICATION SCHEDULE

A. This application schedule is for aboveground insulation outside the building. Loose-fill insulation, for belowground piping, is specified in Division 2 piping distribution Sections.

B. Service: Domestic water.
1. Operating Temperature: 60 to 180 deg F.
2. Insulation Material: Cellular glass, with jacket
3. Insulation Thickness: Apply the following insulation thicknesses:
   a. Pipe, 1" or less: 2.0 inch.
   b. Pipe, 1-1/4" and larger: 2.0 inch.
4. Jacket: Aluminum.
5. Vapor Retarder Required: No.
6. Finish: None.

C. Service: Storm water.
   1. Operating Temperature: 32 to 100 deg F.
   2. Insulation Material: Flexible elastomeric.
   3. Insulation Thickness: Apply the following insulation thicknesses:
      a. Pipe, 1-1/4" to 2": 0.5 inch.
      b. Pipe, 2-1/2" and up: 1.0 inch.
   4. Field-Applied Jacket: Aluminum.
   5. Vapor Retarder Required: Yes.
   6. Finish: None.

END OF SECTION

SECTION 22 10 05
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Domestic water.
   2. Gas / LP / Propane
   3. Flanges, unions, and couplings.
   4. Pipe hangers and supports.
   5. Ball valves.
   6. Valves.
   7. Flow controls.
   8. Check.
   9. Water pressure reducing valves.
   10. Relief valves.
   11. Strainers.

1.02 RELATED REQUIREMENTS

A. Section 31 23 16 - Excavation.
B. Section 31 23 23 - Fill.
C. Section 31 23 16.13 - Trenching.
D. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems.
E. Section 07 84 00 - Firestopping.
F. Section 08 31 00 - Access Doors and Panels.
G. Section 09 90 00 - Painting and Coating.
H. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
I. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
J. Section 22 07 19 - Plumbing Piping Insulation.
K. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
L. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
G. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

J. ASME B31.1 - Power Piping.

K. ASME B31.2 - Fuel Gas Piping; The American Society of Mechanical Engineers.

L. ASME B31.9 - Building Services Piping.

M. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers.

N. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications.

O. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

P. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

Q. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.

R. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

S. ASTM B32 - Standard Specification for Solder Metal.

T. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.

U. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

V. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed.

W. ASTM B68M - Standard Specification for Seamless Copper Tube, Bright Annealed (Metric).

X. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.

Y. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric).

Z. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

AA. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

AB. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

AC. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.

AD. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).

AE. ASTM C4 - Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile.

AF. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.

AG. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, Culvert Pipe (Metric).

AH. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

AI. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).

AJ. ASTM C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

AK. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

AL. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

AM. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

AN. ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

AO. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.

AP. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

AQ. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

AR. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

AS. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

AT. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter; 2003.

AU. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

AV. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.

AW. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

AX. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.

AY. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.

AZ. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

BA. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

BB. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

BC. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

BD. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

BE. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.

BF. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.

BG. ASTM D2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

BH. ASTM D2997 - Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

BI. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

BJ. ASTM D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

BK. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.

BL. ASTM D3754 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.

BM. ASTM D3840 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications.

BN. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

BO. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

BP. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

BQ. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

BR. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).

BS. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

BT. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

BU. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core.

BV. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

BW. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

BX. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.

BY. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe.

BZ. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

CA. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

CB. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

CC. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

CD. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

CE. AWWA C651 - Disinfecting Water Mains.

CF. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

CG. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.

CH. AWWA C950 - Fiberglass Pressure Pipe.

CI. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.

CJ. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

CK. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

CL. MSS SP-67 - Butterfly Valves.

CM. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

CN. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

CO. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.

CP. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

CQ. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

CR. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.

CS. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

CT. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

CU. NFPA 54 - National Fuel Gas Code; National Fire Protection Association.

CV. NFPA 58 - Liquefied Petroleum Gas Code; National Fire Protection Association.

1.04 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with local standards.
   1. Maintain one copy on project site.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME (BPV IX).

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 REGULATORY REQUIREMENTS

A. Perform Work in accordance with local plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.09 EXTRA MATERIALS

A. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.01 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

2.02 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: NFPA 54, threaded or welded to ASME B31.1 or ASME B31.9.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:
   1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
   2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Conform to ASME B31.9.
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.05 GATE VALVES

A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Up To and Including 3 Inches:
1. 1, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

C. 2 Inches and Larger:
1. 1, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.06 GLOBE VALVES

A. Manufacturers:

1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Up To and Including 3 Inches:
1. 1, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends.

C. 2 Inches and Larger:
1. 1, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.07 BALL VALVES

A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

C. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.08 PLUG VALVES

A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Construction 2-1/2 Inches and Larger: 1, 175 psi CWP, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.09 BUTTERFLY VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM, Buna N, or EPT seat, wafer, lug, or grooved ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.10 FLOW CONTROLS

A. Manufacturers:
1. ITT Bell & Gossett: www.bellgossett.com.
2. Griswold Controls: www.griswoldcontrols.com.
3. Taco, Inc: www.taco-hvac.com.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi psi.

2.11 SWING CHECK VALVES

A. Manufacturers:
   1. Hammond Valve: www.hammondvalve.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Up to 3 Inches:
   1. 1, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

C. Over 3 Inches:
   1. 1, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.12 SPRING LOADED CHECK VALVES

A. Manufacturers:
   1. Hammond Valve: www.hammondvalve.com.
   2. Crane Co.: www.cranevalve.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.13 WATER PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com/#sle.
   2. Cla-Val Co: www.cla-val.com/#sle.
   3. Watts Regulator Company: www.wattsregulator.com/#sle.

B. Up to 2 Inches:
   1. MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single or double union ends.

C. Over 2 Inches:
   1. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.14 RELIEF VALVES

2.15 STRAINERS

2.16 RELIEF VALVES

A. Pressure Relief:
   1. Manufacturers:
      a. Cla-Val Co: www.cla-val.com.
      b. Henry Technologies: www.henrytech.com.
      c. Watts Regulator Company: www.wattsregulator.com.
   2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:
   1. Manufacturers:
      a. Cla-Val Co: www.cla-val.com.

b. Henry Technologies: www.henrytech.com.
c. Watts Regulator Company: www.wattsregulator.com.

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

2.17 STRAINERS

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com.
2. Green Country Filter Manufacturing: www.greencountryfilter.com.
3. WEAMCO: www.weamco.com.

B. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5 inch and Larger:
1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.

I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly .

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.

N. Excavate in accordance with Section 31 23 16.

O. Backfill in accordance with Section 31 23 23.

P. Install bell and spigot pipe with bell end upstream.

Q. Install valves with stems upright or horizontal, not inverted.

R. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

S. Install water piping to ASME B31.9.

T. Install fuel oil piping to ASME B31.9.

U. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

V. Sleeve pipes passing through partitions, walls and floors.

W. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

X. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 05 48.
11. Support cast iron drainage piping at every joint.

3.04 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install globe valves for throttling, bypass, or manual flow control services.

F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

G. Provide spring loaded check valves on discharge of water pumps.

H. Provide plug valves in natural gas systems for shut-off service.

I. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 33 01 10.58.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve.

1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
2. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

C. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.08 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe size: 1/2 inches to 1-1/4 inches:
         1) Maximum hanger spacing: 6.5 ft.
         2) Hanger rod diameter: 3/8 inches.
      b. Pipe size: 1-1/2 inches to 2 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 3/8 inch.
      c. Pipe size: 2-1/2 inches to 3 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 1/2 inch.
      d. Pipe size: 4 inches to 6 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 5/8 inch.
      e. Pipe size: 8 inches to 12 inches:
         1) Maximum hanger spacing: 14 ft.
         2) Hanger rod diameter: 7/8 inch.
      f. Pipe size: 14 inches and Over:
         1) Maximum hanger spacing: 20 ft.
         2) Hanger rod diameter: 1 inch.
   2. Plastic Piping:
      a. Pipe Size 1" to 6":
         1) Maximum hanger spacing: 6 ft.
         2) Hanger rod diameter: 3/8 inch.
      b. Pipe Size 8" and Over:
         1) Maximum hanger spacing: 6 ft.
         2) Hanger rod diameter: 7/8 inch.

END OF SECTION

SECTION 22 10 06
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof and floor drains.
B. Cleanouts.
C. Hydrants.
D. Backflow preventers.
E. Water hammer arrestors.
F. Interceptors.
G. Thermostatic mixing valves.
H. Catch basins and manholes.

1.02 RELATED REQUIREMENTS

A. Section 33 05 61 - Concrete Manholes.
B. Section 03 30 00 - Cast-in-Place Concrete: Manhole bottoms.
C. Section 22 10 05 - Plumbing Piping.
D. Section 22 40 00 - Plumbing Fixtures.
E. Section 22 30 00 - Plumbing Equipment.
F. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains.
B. ASME A112.6.4 - Roof, Deck, and Balcony Drains.
C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.
E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.
F. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance.
G. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
H. ASTM C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections (Metric).
I. PDI-WH 201 - Water Hammer Arresters.

1.04 SUBMITTALS

A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
C. Certificates: Certify that grease or oil interceptors meet or exceed specified requirements.
D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

F. Operation Data: Indicate frequency of treatment required for interceptors.

G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 BACKFLOW PREVENTERS

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com/#sle.
   2. Watts Regulator Company: www.wattsregulator.com/#sle.
   3. Zurn Industries, Inc: www.zurn.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Reduced Pressure Backflow Preventers:
   1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.02 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com/#sle.
   2. Watts Regulator Company: www.wattsregulator.com/#sle.
   3. Zurn Industries, Inc: www.zurn.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Double Check Valve Assemblies:
   1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.03 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   2. Watts Regulator Company: www.wattsregulator.com/#sle.
   3. Zurn Industries, Inc: www.zurn.com/#sle.
   4. Souix Chief Company.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Water Hammer Arrestors:
   1. Stainless steel construction, bellows or piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

2.04 MIXING VALVES

A. Thermostatic Mixing Valves:
   1. Manufacturers:
      a. ESBE: www.esbe.se/en.
      b. Leonard Valve Company: www.leonardvalve.com.
      c. Honeywell Water Controls: http://yourhome.honeywell.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
   3. Accessories:
      a. Check valve on inlets.
      b. Volume control shut-off valve on outlet.
      c. Stem thermometer on outlet.
      d. Strainer stop checks on inlets.
   4. Cabinet: 16 gage prime coated steel, for recessed mounting with keyed lock.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water heaters.

B. Expansion Tanks.

C. Pumps.
   1. Circulators.
   2. Sump / Sewage Pumps.

D. Water pressure booster system.

1.02 RELATED REQUIREMENTS

A. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.

B. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous.

C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.

1.04 SUBMITTALS

A. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements.
   3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.

B. Shop Drawings:
   1. Indicate heat exchanger dimensions, size of tappings, and performance data.
   2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

C. Manufacturer's Instructions .

D. Project Record Documents: Record actual locations of components .

E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of experience.

B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 CERTIFICATIONS

A. Water Heaters: NSF approved.

B. Gas Water Heaters: Certified by CSA International to 1 or 2, as applicable, in addition to requirements specified elsewhere.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

A. Provide five year manufacturer warranty for domestic water heaters and in-line circulator.

1.09 EXTRA MATERIALS

A. Provide two pump seals.

PART 2 PRODUCTS

2.01 COMMERCIAL GAS FIRED WATER HEATERS

A. Type: Automatic, tankless propane-fired.

B. Manufacturers:
   1. Noritz
   2. Rinnai
   3. Substitutions: See Section 01 60 00 - Product Requirements.

C. Performance: See plans.

D. Accessories: Provide:
   1. Venting Kit.
   2. Isolation Valves

E. Certification: As water heater by ASME, rated for output temperatures of 100 to 180 degrees F.

F. Controls: Digital controls for output temperature management (default setting at 120 degrees), safety controls for flame failure, boiling protection, combustion fan failure, over-current, and gas valve failure. .

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com/#sle.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Taco, Inc: www.taco-hvac.com/#sle.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 55 psig.

2.03 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc: www.armstrongpumps.com/#sle.
2. ITT Bell & Gossett: www.bellgossett.com/#sle.
3. SIHI Group: www.sterlingsihi.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Casing: Bronze, rated for 125 psig working pressure.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

2.04 PRESSURE BOOSTER SYSTEMS

A. Manufacturers: See Schedule

B. System: Packaged with two pumps, factory assembled, tested, and adjusted; shipped to site as integral unit; consisting of pumps, valves, and piping, with control panel assembled on fabricated steel base with structural steel framework.

C. Structural Elements: The entire system shall be factory skid mounted on a minimum; 304 stainless-steel structural square tube support frame, with in-shear molded rubber vibration isolators. Horizontal systems shall feature a rack-style servicing system which will allow the user access to the pump and motor while the pump can remains on the system skid. (see plans for details)

D. Valves: All valves shall be full port bronze ball valves, with S.S. ball and stem design for valve sizes 2 1/2" and smaller, and cast iron, epoxy coated lever operated, grooved end type butterfly valves, with stainless steel disc, and Stainless Steel shaft, for valve sizes 3" and larger. Valves must be rated for maximum pressure service for the system and also comply with NSF 61 Drinking Water requirements.

E. Control Panel: The pumping system control panel shall incorporate the following elements, and criteria:

1. The pump controller, and all its components shall be housed in a NEMA 3R, UL listed, ventilated control enclosure. The controller shall have a main power disconnect switch, with enclosure door interlock, which shall require opening the disconnect switch before the control cabinet may be opened. The system shall provide for a single point electrical connection, with all power, both primary, and secondary to be de-activated with opening the main disconnect switch.
2. The entire controller shall be UL 508A listed, INDUSTRIAL CONTROL PANELS, and have all UL listed devices of Touch Safe design, which shall eliminate any bare handed shock hazard. All primary and secondary power circuits shall be protected through the use of Touch Safe panel design.
3. All secondary control circuit wiring shall be 24 volts, AC/DC, or less, to include all pilot lights, selector switches, panel meters, HMI, PLC and alarm devices. The Primary motor branch circuits shall have thermal magnetic circuit breaker protection, (fuses shall not be acceptable). There shall be no part of the interior of the control enclosure, which shall produce a bare handed shock hazard even with the controller powered up. There shall be no exceptions to this requirement.
4. The controller shall utilize a programmable 24 volt EEPROM control module, which shall provide all pump staging, and timing functions. Low Suction and High System alarm conditions shall have audible and visual indicators, with timed delayed proof of condition and automatic reset. The EEPROM Module shall provide for automatic alternation between equal pumps. Pressure-based pump sequencing is unacceptable since a change in suction pressure can skew the lag sequencing point. Pump sequencing must

be accomplished through electronic means allowing for the lag pump to carry the load prior to the lead handing off. Control system will guarantee PSI deviation of no more than +/- 1PSI on pump time-out alternation. Pump alternation shall enunciate on the main screen. There shall be no failure of any one system component which will render the system incapable of maintaining system flow to the building. All controls must be 100% fail-safe including failure of the PLC.

5. The controller panel shall have the following features:
   a. NEMA 4, 256 color, 6" Touch Screen interface shall provide access to all timing, control and informational feedback on all system operations. This HMI shall provide for re-calibration of the system and all system parameters without the need to open the control panel door.
   b. Touch screen shall include panel screen access to a logged alarm function with time and date stamp.
   c. Touch screen shall incorporate a key logger able to save the last 400 button pushes in a non-volatile PLC memory.
   d. Touch screen shall incorporate a PSI trending chart with the ability to export information including VFD speed, system PSI, KW, run times in an exportable CSV format on an externally removable USB flash drive.
   e. All pump functions shall be accessible including Run Hours, Amperage, PSI and system temperature and remaining time until shutdown.
   f. System shall provide for an optional BACNet communications including the ability to monitor and control the system remotely.
   g. Provide three phase lightning protection for entire control panel.
   h. Main power un-fused, door interlocked disconnect switch.
   i. Individual, glycerin filled, panel mounted, stainless steel suction and system pressure gauges.
   j. Low Suction Condition, and High System Pressure alarms, both audible, and visual
   k. Automatic pump alternation between equal split pumps.
   l. Low suction condition shall be initiated via a separate dedicated pressure switch(for pressure feed systems), or a liquid level float switch, (for break tank operation).
   m. All control components shall be UL Listed, or recognized devices.
   n. The controller shall be UL 508 Listed, and in accordance with the National Electrical Code, (NEC).
6. All components shall be of standard manufacture, and not be of proprietary sole source. Manufacturer will have these spare parts available either through local product representation or directly from the manufacturer via Next Day shipping.

F. Pump Sequencing: All pump sequencing shall be initiated and controlled via the PLC. Upon pressure drop, the Lead pump shall initiate and run to attempt to satisfy demand. An empty pipe condition is to be determined by an algorithm allowing for a slow ramp to set point to prevent system pressure shocks. In the event the pressure set point is not satisfied or the pump is being overloaded, an additional pump shall immediately initiate to assist the lead pump in meeting demand. After the pressure set point is reached, the pumps shall continue to meet demand, if demand decreases, a sensor less means of control shall immediately shut down the pump to prevent no flow conditions and to prevent short cycling of the pumps. These algorithms take into account system pressure and system demand, the system shall revert to the stand-by mode (no flow shutdown) when no flow is present. A continuously monitored motor FLA algorithm shall prevent any motor from overloading and initialize additional pumps to share system demand. The system shall employ algorithms to detect pipe break and stop system, initiate an alarm and log the event. In the event of a sensor loss, the system shall run one pump in a semi-automatic mode allowing the building to maintain a minimum pressure until the sensor can be repaired or replaced. An automated PID algorithm shall continuously monitor

system pressure and auto-tune the PID based on demand allowing for fast system demand response while maintaining smooth steady state pressure. The PID algorithms shall incorporate intelligent algorithms to start the pumps at the point of creating pressure saving energy and reducing time to set pressure upon pump call. The software will also contain GreenFlo™, an algorithm to allow the system to fully comply with the newly adopted requirements of ANSI/ASHRAE/IES, Standard 90.1 - 2010; also referred to as the "Energy Standard for Buildings".

G. The system shall not require external flow meters or KW monitoring. The system will not implement speed, thermal or time delay means to detect and shut down pumps on a no demand condition as this wastes energy and provides for unnecessary run times.

H. Bladder Tank: No bladder tank is recommended, or required for this type system as there is no pressure change at the discharge of the pump. Since there is no pressure change, a tank is un-usable in a variable speed booster application.

I. Pressure Regulation: Pressure regulation is provided via the variable frequency drive controllers, with PID control. No other pressure regulators are required. In the event of any drive failure, next drive in sequence shall start automatically and the failed drive shall indicate a fault condition. In the event of a loss of transducer signal, the system shall be pre-programmed to a fail-safe mode which will ramp pumps to a safe-speed and maintain positive pressure on the system piping without shutting the system down. All system and drive settings shall be re-settable from the HMI (touch screen) including PID values without the need to open the controller door.

J. Fabrication:
   1. All headers, nipples, and welded attachments to the headers shall be type 304 stainless steel materials.
   2. All welding shall be in accordance with section IX of the ASME Boiler and Pressure Vessel code, and shall be performed by welders qualified under that standard
   3. The completed system shall be hydrostatically and performance tested to simulated jobsite conditions and pre-set for plug and play operation. Copies of these test reports shall be provided in the O&M Manuals which will be turned over to the owner. These manuals shall included all settings, explanation of these operations and final test reports from the factory test.
   4. Each pump shall have an individual resilient seated non-slam type check valve on each pump immediately downstream of the pump discharge.
   5. All pumps shall be mounted utilizing in-shear rubber vibration isolators mounted to the motor bases
   6. All stainless steel surfaces shall feature a consistent brushed metal finish so that all exposed stainless surfaces are identical in material finish.

K. Start-up:
   1. Initial factory start-up, and owner training shall be performed by a qualified factory trained technician. A factory certified start-up report must be provide to the owner, dated and signed by the factory technician.

L. Parts: A complete listing of all components in the manufacture of the equipment shall be provide in the O&M including individual factory part numbers for each component in the packaged equipment.

M. Owner Training: The owner instruction, and training shall include, but not be limited to the following:
   1. Training in the replacement of the motor, mechanical seals and pump impeller.
   2. Safe replacement of electrical components.
   3. Proper operation of the system, troubleshooting, alarm, and reset features

N. On-Site Factory Warranty: Provide a 2-year Factory sponsored extended warranties for all equipment servicing common areas. Warranty shall include both parts and labor in the event of a failure of any equipment in accordance with factory warranty certificate. Warranty repairs must be performed by the manufacturer or a properly trained factory authorized service representative.

2.05 SUMP PUMPS

A. Manufacturers:
   1. ITT Bell & Gossett.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Type: Vertical centrifugal, direct connected, duplex arrangement.

C. Casing: Cast iron volute with radial clearance around impeller .

D. Impeller: Cast iron; enclosed or semi-open non-clog, keyed to stainless steel shaft.

E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.

F. Bearings: Forced grease lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.

G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.

H. Sump: Fiberglass with lockable painted aluminum inspection cover and alarm fittings.

I. Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps, cut-in second pump on rising level or lead pump failure, separate pressure switch high level alarm with transformer, alarm bell, and standpipe, and emergency float switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related gas venting and electrical work to achieve operating system.

C. Pumps:
   1. Provide air cock and drain connection on horizontal pump casings.
   2. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
   3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
   4. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
   5. Align and verify alignment of base mounted pumps prior to start-up.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 2 PRODUCTS

1.01 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

1.02 APPLICATIONS

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CON. FOR EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolators.

1.02 RELATED REQUIREMENTS

1.03 SUBMITTALS

A. Product Data: Provide schedule of vibration isolator type with location and load on each.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.

C. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Isolation Technology, Inc: www.isolationtech.com.

B. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.

C. Mason Industries: www.mason-ind.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

A. General:
   1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
   2. Steel springs to function without undue stress or overloading.

2.03 VIBRATION ISOLATORS

A. Non-Seismic Type:
   1. All Elastomeric-Fiber Glass Pads:
      a. Configuration: Flat or molded.
      b. Thickness: 0.25 inch minimum.
      c. Assembly: Single or multiple layers using bonded, galvanized sheet metal separation plate between each layer with load plate providing evenly distributed load over pad surface.
   2. Elastomeric Mounts:
      a. Material: Oil, ozone, and oxidant resistant compounds.
      b. Assembly: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
   3. Steel Springs:
      a. Assembly: Freestanding, laterally stable without housing.
      b. Leveling Device: Rigidly connected to equipment or frame.
   4. Restrained Steel Springs:
      a. Housing: Rigid blocking during rigging prevents equipment installed and operating height from changing during temporary weight reduction.
      b. Equipment Wind Loading: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
   5. Elastomeric Hangers:
      a. Housing: Steel construction containing elastomeric isolation element to prevent rod contact with housing and short-circuiting of isolating function.

b. Incorporate steel load distribution plate sandwiching elastomeric element to housing.

6. Spring Hanger:
   a. Housing: Steel construction containing stable steel spring and integral elastomeric element preventing metal to metal contact.
   b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
7. Combination Elastomeric-Spring Hanger:
   a. Housing: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
   b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
8. Thrust Restraints:
   a. Housing: Steel construction containing stable steel spring and integral elastomeric element installed in pairs to resist air pressure thrusts.
   b. Bottom Openings: Sized to allow plus/minus 15 degrees rod misalignment.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Bases:
   1. Set steel bases for one inch clearance between housekeeping pad and base.
   2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
   3. Adjust equipment level.

C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.

F. Provide seismic snubbers for all equipment, piping, and ductwork mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.

G. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:
   1. Up to 4 Inches Pipe Size: First three points of support.
   2. 5 to 8 Inches Pipe Size: First four points of support.
   3. 10 inches Pipe Size and Over: First six points of support.
   4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.02 FIELD QUALITY CONTROL

A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.03 SCHEDULE

A. Pipe Isolation Schedule.
   1. 1 Inch Pipe Size: Isolate 120 diameters from equipment.
   2. 2 Inch Pipe Size: Isolate 90 diameters from equipment.
   3. 3 Inch Pipe Size: Isolate 80 diameters from equipment.

4. 4 Inch Pipe Size: Isolate 75 diameters from equipment.
5. 6 Inch Pipe Size: Isolate 60 diameters from equipment.
6. 8 Inch Pipe Size: Isolate 60 diameters from equipment.
7. 10 Inch Pipe Size: Isolate 54 diameters from equipment.
8. 12 Inch Pipe Size: Isolate 50 diameters from equipment.
9. 16 Inch Pipe Size: Isolate 45 diameters from equipment.
10. 24 Inch Pipe Size: Isolate 38 diameters from equipment.
11. Over 24 Inch Pipe Size: As indicated.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Samples: Submit two labels or tags 1/2 x 4 inch in size.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Tags.

C. Automatic Controls: Tags. Key to control schematic.

D. Control Panels: Nameplates.

E. Dampers: Ceiling tacks, where located above lay-in ceiling.

F. Heat Transfer Equipment: Nameplates.

G. Instrumentation: Tags.

H. Major Control Components: Nameplates.

I. Piping: Tags.

J. Pumps: Nameplates.

K. Relays: Tags.

L. Small-sized Equipment: Tags.

M. Tanks: Nameplates.

N. Thermostats: Nameplates.

O. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Champion America, Inc: www.Champion-America.com.

C. Seton Identification Products: www.seton.com/aec.

2.03 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/2 inch.
   3. Background Color: Black.

2.04 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.05 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
   2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
   3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
   4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
   5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
   6. Ductwork and Equipment: 2-1/2 inch high letters.

B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

2.06 PIPE MARKERS

A. Color: Conform to ASME A13.1.

B. For refrigerant piping, provide pipe markers to identify the following:
   1. Refrigerant state (high pressure gas, low pressure gas, or liquid)
   2. Connected equipment, HP or FC.
   3. Connected room number(s), where applicable.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. Color code as follows:

1. Coordinate with owner.

2.07 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. Coordinate with owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Refrigerant piping shall be labeled with the refrigerant state (high pressure gas, low pressure gas, or liquid) as well as the connected fan coil and associated room served.

D. Apply stencil painting in accordance with Section 09 90 00.

E. Install plastic pipe markers in accordance with manufacturer's instructions.

F. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

I. Identify control panels and major control components outside panels with plastic nameplates.

J. Identify thermostats relating to terminal boxes or valves with nameplates.

K. Identify valves in main and branch piping with tags.

L. Identify air terminal units and radiator valves with numbered tags.

M. Tag automatic controls, instruments, and relays. Key to control schematic.

N. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

O. Identify ductwork with plastic nameplates or stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

P. Locate ceiling tacks to locate valves, units, or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Sound measurement of equipment operating conditions.

E. Vibration measurement of equipment operating conditions.

1.02 RELATED REQUIREMENTS

A. Section 01 91 10 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

B. Section 01 91 10 - Functional Testing Procedures

1.03 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

1.04 SUBMITTALS

A. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor.
   3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   5. Include at least the following in the plan:
      a. Preface: An explanation of the intended use of the control system.
      b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      d. Identification and types of measurement instruments to be used and their most recent calibration date.
      e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      f. Final test report forms to be used.

g. Detailed step-by-step procedures for TAB work for each system and issue, including:
   1) Terminal flow calibration (for each terminal type).
   2) Diffuser proportioning.
   3) Branch/submain proportioning.
   4) Total flow calculations.
   5) Rechecking.
   6) Diversity issues.
h. Expected problems and solutions, etc.
i. Criteria for using air flow straighteners or relocating flow stations and sensors .
j. Details of how TOTAL flow will be determined; for example:
   1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
   2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
n. Method of checking building static and exhaust fan and/or relief damper capacity.
o. Proposed selection points for sound measurements and sound measurement methods.
p. Methods for making coil or other system plant capacity measurements, if specified.
q. Time schedule for TAB work to be done in phases (by floor, etc.).
r. Description of TAB work for areas to be built out later, if any.
s. Time schedule for deferred or seasonal TAB work, if specified.
t. False loading of systems to complete TAB work, if specified.
u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
v. Interstitial cavity differential pressure measurements and calculations, if specified.
w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
x. Procedures for formal progress reports, including scope and frequency.
y. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Field Logs: Submit at least once a week to Commissioning Authority and Construction Manager.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Progress Reports.

F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor within two weeks after completion of testing, adjusting, and balancing.
   2. Revise TAB plan to reflect actual procedures and submit as part of final report.
   3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
7. Units of Measure: Report data in I-P (inch-pound) units only.
8. Include the following on the title page of each report:
   a. Name of Testing, Adjusting, and Balancing Agency.
   b. Address of Testing, Adjusting, and Balancing Agency.
   c. Telephone number of Testing, Adjusting, and Balancing Agency.
   d. Project name.
   e. Project location.
   f. Project Architect.
   g. Project Engineer.
   h. Project Contractor.
   i. Project altitude.
   j. Report date.

G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

1.05 QUALITY ASSURANCE (MOVED TO PART 3)

1.06 PRE-BALANCING MEETING (MOVED TO PART 3)

1.07 SEQUENCING AND SCHEDULING (MOVED TO PART 3)

1.08 WARRANTY (MOVED TO PART 3)

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC MN-1, AABC National Standards for Total System Balance.
   2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
   3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
   4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
   5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:

a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities .

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive and sheave changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

O. On fan powered VAV boxes, adjust air flow switches for proper operation.

P. For laboratories, lab classrooms, and prep rooms, offset CFM values (differential between exhaust/return and supply airflows) shall be required to maintain a plus 10% minus 5% offset.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 SCOPE

A. Test, adjust, and balance the following:
   1. Plumbing Pumps
   2. HVAC Pumps/Hydronic Systems
   3. Condensing Boilers
   4. Hot Water Generators
   5. Energy Recovery Ventilator Units
   6. Fans
   7. Air Filters
   8. Air Inlets and Outlets

3.09 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer
   2. Model/Frame
   3. HP/BHP
   4. Phase, voltage, amperage; nameplate, actual, no load
   5. RPM
   6. Service factor
   7. Starter size, rating, heater elements
   8. Sheave Make/Size/Bore

B. V-Belt Drives:
   1. Identification/location
   2. Required driven RPM
   3. Driven sheave, diameter and RPM
   4. Belt, size and quantity
   5. Motor sheave diameter and RPM
   6. Center to center distance, maximum, minimum, and actual

C. Pumps:
   1. Identification/number

2. Manufacturer
3. Size/model
4. Impeller
5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge and suction pressures
12. Shut off, total head pressure

D. Combustion Equipment:
1. Model number
2. Serial number
3. Firing rate
4. Gas meter timing dial size
5. Gas meter time per revolution
6. Gas pressure at meter outlet
7. Gas flow rate
8. Heat input
9. Burner manifold gas pressure
10. Percent combustion efficiency
11. Heat output

E. Hot Water Generators:
1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Model number
6. Serial number
7. Primary water entering temperature, design and actual
8. Primary water leaving temperature, design and actual
9. Primary water flow, design and actual
10. Primary water pressure drop, design and actual
11. Secondary water leaving temperature, design and actual
12. Secondary water leaving temperature, design and actual
13. Secondary water flow, design and actual
14. Secondary water pressure drop, design and actual

F. Electric Duct Heaters and Unit Heaters:
1. Manufacturer
2. Identification/number
3. Location
4. Model number
5. Design kW
6. Number of stages
7. Phase, voltage, amperage
8. Test voltage (each phase)
9. Test amperage (each phase)
10. Air flow, specified and actual

11. Temperature rise, specified and actual

G. Air Moving Equipment:
   1. Location
   2. Manufacturer
   3. Model number
   4. Serial number
   5. Arrangement/Class/Discharge
   6. Air flow, specified and actual
   7. Return air flow, specified and actual
   8. Outside air flow, specified and actual
   9. Total static pressure (total external), specified and actual
   10. Inlet pressure
   11. Discharge pressure
   12. Sheave Make/Size/Bore
   13. Number of Belts/Make/Size
   14. Fan RPM

H. Return Air/Outside Air:
   1. Identification/location
   2. Design air flow
   3. Actual air flow
   4. Design return air flow
   5. Actual return air flow
   6. Design outside air flow
   7. Actual outside air flow
   8. Return air temperature
   9. Outside air temperature
   10. Required mixed air temperature
   11. Actual mixed air temperature
   12. Design outside/return air ratio
   13. Actual outside/return air ratio

I. Duct Traverses:
   1. System zone/branch
   2. Duct size
   3. Area
   4. Design velocity
   5. Design air flow
   6. Test velocity
   7. Test air flow
   8. Duct static pressure
   9. Air temperature
   10. Air correction factor

J. Duct Leak Tests:
   1. Description of ductwork under test
   2. Duct design operating pressure
   3. Duct design test static pressure
   4. Duct capacity, air flow
   5. Maximum allowable leakage duct capacity times leak factor
   6. Test apparatus

a. Blower
b. Orifice, tube size
c. Orifice size
d. Calibrated

7. Test static pressure
8. Test orifice differential pressure
9. Leakage

K. Flow Measuring Stations:
1. Identification/number
2. Location
3. Size
4. Manufacturer
5. Model number
6. Serial number
7. Design Flow rate
8. Design pressure drop
9. Actual/final pressure drop
10. Actual/final flow rate
11. Station calibrated setting

L. Terminal Unit Data:
1. Manufacturer
2. Type, constant, variable, single, dual duct
3. Identification/number
4. Location
5. Model number
6. Size
7. Minimum static pressure
8. Minimum design air flow
9. Maximum design air flow
10. Maximum actual air flow
11. Inlet static pressure

M. Air Distribution Tests:
1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

N. Sound Level Reports:
1. Location
2. Octave bands - equipment off
3. Octave bands - equipment on

O. Vibration Tests:
1. Location of points:

a. Fan bearing, drive end
b. Fan bearing, opposite end
c. Motor bearing, center (if applicable)
d. Motor bearing, drive end
e. Motor bearing, opposite end
f. Casing (bottom or top)
g. Casing (side)
h. Duct after flexible connection (discharge)
i. Duct after flexible connection (suction)

2. Test readings:
   a. Horizontal, velocity and displacement
   b. Vertical, velocity and displacement
   c. Axial, velocity and displacement
3. Normally acceptable readings, velocity and acceleration
4. Unusual conditions at time of test
5. Vibration source (if non-complying)

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct Lagging.

C. Insulation jackets.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating: Painting insulation jackets.

B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

C. Section 23 05 53 - Identification for HVAC Piping and Equipment.

D. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

K. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.

L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experienceand approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Owens Corning Corp: www.owenscorning.com/#sle.
   4. CertainTeed Corporation: www.certainteed.com/#sle.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. Minimum "R" Value: Minimum R value of (6) is required for interior installations in conditioned plenum spaces and a minimum R value of (12) is required for exterior installations and in unconditioned plenum spaces.
   2. Maximum Service Temperature: 450 degrees F.
   3. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Tie Wire: Annealed steel, 16 gage.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Owens Corning Corp: www.owenscorning.com.
   4. CertainTeed Corporation: www.certainteed.com/#sle.

B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. Minimum "R" Value: Minimum R value of (6) is required for interior installations in conditioned plenum spaces and a minimum R value of (12) is required for exterior installations and in unconditioned plenum spaces.
2. Maximum service temperature: 450 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent.

C. Vapor Barrier Jacket:
1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive:
a. Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.05 DUCT LAGGING

A. Manufacturers:
1. Sound Seal: www.soundseal.com
2. Kinetics Noise Control: www.kineticsnoise.com.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Lagging: Loaded vinyl noise barrier with a scrim reinforced aluminum foil facing on one side with a 1" thick fiberglass decoupler.
1. Apparent Thermal Conductivity: Maximum of.25 at 75 degrees F
2. Service Temperature: Up to 350 degrees F.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting unless noted otherwise.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section. Provide tapered caps on all horizontal ducts for shedding water.

G. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 SCHEDULES

A. INDOOR DUCT AND PLENUM APPLICATION SCHEDULE
   1. NOTE: Apply duct lagging where indicated on drawings.
   2. Service: Round, supply-air ducts, concealed.
      a. Material: Mineral-fiber blanket.
      b. Thickness: 2 inches.
      c. Minimum "R" value: 6.
      d. Jacket: Foil and paper.
      e. Vapor Retarder Required: Yes.
   3. Service: Round, return-air ducts, concealed.
      a. Material: Mineral-fiber blanket.
      b. Thickness: 2 inches.
      c. Minimum "R" value: 6.
      d. Jacket: Foil and paper.
      e. Vapor Retarder Required: No.
   4. Service: Round, outside-air ducts, concealed.
      a. Material: Mineral-fiber blanket
      b. Thickness: 2 inches.
      c. Minimum "R" value: 6.
      d. Jacket: Foil and paper.
      e. Vapor Retarder Required: Yes.
   5. Service: Rectangular, supply-air ducts, concealed.
      a. Material: Mineral-fiber blanket
      b. Thickness: 2 inches.

c. Minimum "R" value: 6.
d. Jacket: Foil and paper.
e. Vapor Retarder Required: Yes.

6. Service: Rectangular, return-air ducts, concealed.
   a. Material: Mineral-fiber blanket
   b. Thickness: 2 inches.
   c. Minimum "R" value: 6.
   d. Jacket: Foil and paper.
   e. Vapor Retarder Required: No.
7. Service: Rectangular, outside-air ducts, concealed.
   a. Material: Mineral-fiber blanket
   b. Thickness: 2 inches.
   c. Minimum "R" value: 6.
   d. Jacket: Foil and paper.
   e. Vapor Retarder Required: Yes.
8. Service: Round, supply-air ducts, exposed.
   a. Material: Mineral-fiber blanket
   b. Thickness: 2 inches.
   c. Minimum "R" value: 6.
   d. Jacket: Spiral-wound steel, paintable.
   e. Vapor Retarder Required: Yes.
   f. NOTE: Provide double-walled spiral ductwork in areas not concealed above ceilings. and where noted.
9. Service: Round, return-air ducts, exposed.
   a. Material: Mineral-fiber blanket.
   b. Thickness: 2 inches.
   c. Minimum "R" value: 6.
   d. Jacket: Spiral-wound steel, paintable.
   e. Vapor Retarder Required: No.
   f. NOTE: Provide double-walled spiral ductwork in areas not concealed above ceilings. and where noted.
10. Service: Round, outside-air ducts, exposed.
    a. Material: Mineral-fiber blanket.
    b. Thickness: 2 inches.
    c. Minimum "R" value: 6.
    d. Jacket: Spiral-wound steel, paintable.
    e. Vapor Retarder Required: Yes.
    f. NOTE: Provide double-walled spiral ductwork in areas not concealed above ceilings. and where noted.
11. Service: Rectangular, supply-air ducts, exposed.
    a. Material: Mineral-fiber board.
    b. Thickness: 2 inches.
    c. Minimum "R" value: 6.
    d. Jacket: Canvas, painted to architects specifications.
    e. Vapor Retarder Required: Yes.
12. Service: Rectangular, return-air ducts, exposed.
    a. Material: Mineral-fiber board.
    b. Thickness: 2 inches.
    c. Minimum "R" value: 6.
    d. Jacket: Canvas, painted to architects specifications.

e. Vapor Retarder Required: No.

13. Service: Rectangular, outside-air ducts, exposed.
    a. Material: Mineral-fiber board.
    b. Thickness: 2 inches.
    c. Minimum "R" value: 6.
    d. Jacket: Canvas, painted to architects specifications.
    e. Vapor Retarder Required: Yes.
14. Service: Rectangular, range-hood exhaust ducts, concealed.
    a. Material: Calcium silicate.
    b. Thickness: 2 inches.
    c. Field-Applied Jacket: Glass cloth.
    d. Vapor Retarder Required: No.
15. Service: Rectangular, range-hood exhaust ducts, exposed.
    a. Material: Calcium silicate.
    b. Thickness: 2 inches.
    c. Field Applied Jacket: Stainless steel.
    d. Vapor Retarder Required: No.

B. OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE
1. Service: Round, supply-air ducts.
    a. Material: Mineral-fiber board.
    b. Thickness: 4.5 inches.
    c. Minimum "R" value: 12.
    d. Field-Applied Jacket: aluminum
        1) Aluminum Thickness: 0.032 inch
    e. Vapor Retarder Required: Yes.
2. Service: Round, return-air ducts.
    a. Material: Mineral-fiber board.
    b. Thickness: 4.5 inches.
    c. Minimum "R" value: 12.
    d. Field-Applied Jacket: aluminum
        1) Aluminum Thickness: 0.032 inch
    e. Vapor Retarder Required: Yes.
3. Service: Rectangular, supply-air ducts.
    a. Material: Mineral-fiber board.
    b. Thickness: 4.5 inches.
    c. Minimum "R" value: 12.
    d. Field-Applied Jacket: aluminum
        1) Aluminum Thickness: 0.032 inch
    e. Vapor Retarder Required: Yes.
4. Service: Rectangular, return-air ducts.
    a. Material: Mineral-fiber board.
    b. Thickness: 4.5 inches.
    c. Minimum "R" value: 12.
    d. Field-Applied Jacket: aluminum
        1) Aluminum Thickness: 0.032 inch
    e. Vapor Retarder Required: Yes.

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

C. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

I. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

J. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

L. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.

N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

O. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.

P. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

R. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

T. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

U. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.

V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum service temperature: 850 degrees F.
   3. Maximum moisture absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum service temperature: 650 degrees F.
   3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive:
   1. Compatible with insulation.

G. Insulating Cement/Mastic:
   1. ASTM C195; hydraulic setting on mineral wool.

H. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Blanket: 1.0 lb/cu ft density.
   3. Weave: 5x5.

I. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, black color.

J. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Outdoor Breather Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

L. Insulating Cement:
   1. ASTM C449/C449M.

2.03 CELLULAR GLASS

A. Manufacturers:
   1. Pittsburgh Corning Corporation: www.foamglasinsulation.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C552, Grade 1.
   1. 'K' value: 0.37 at 100 degrees F.
   2. Service Temperature: Up to 900 degrees F.
   3. Water Vapor Permeability: 0.005 perm inch.
   4. Water Absorption: 0.2 percent by volume, maximum.

2.04 EXPANDED POLYSTYRENE

A. Insulation: ASTM C578; rigid closed cell.
   1. 'K' value: 0.23 at 75 degrees F.
   2. Maximum service temperature: 165 degrees F.
   3. Maximum water vapor permeance: 5.0 perms

2.05 EXPANDED PERLITE

A. Manufacturers:
   1. Schundler Company: www.schundler.com/#sle.

B. Insulation: ASTM C610, molded.
   1. Maximum service temperature: 1200 degrees F.
   2. Maximum water vapor transmission: 0.1 perm.

2.06 HYDROUS CALCIUM SILICATE

A. Manufacturers:
   1. Johns Manville Corporation: www.jm.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
   1. 'K' value: 2 and C518; 0.40 at 300 degrees F, when tested in accordance with 2 or 1.

2. Maximum service temperature: 1200 degrees F.
3. Density: 15 lb/cu ft.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Insulating Cement:
1. ASTM C449/C449M.

2.07 POLYISOCYANURATE CELLULAR PLASTIC

A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. Dimension: Comply with requirements of ASTM C585.
2. 'K' Value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
3. 'K' value: 0.18 at 75 degrees F, when tested in accordance with 1.
4. Minimum Service Temperature: -70 degrees F.
5. Maximum Service Temperature: 300 degrees F.
6. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842..
7. Moisture Vapor Transmission: 4.0 perm in.
8. Connection: Waterproof vapor barrier adhesive.

2.08 POLYETHYLENE

A. Manufacturers:
1. Armacell International: www.armacell.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. 'K' value: ASTM C177; 0.25 at 75 degrees F.
2. Maximum Service Temperature: 200 degrees F.
3. Density: 2 lb/cu ft.
4. Maximum Moisture Absorption: 1.0 percent by volume.
5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
6. Connection: Contact adhesive.

2.09 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
1. Armacell International: www.armacell.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 3; use molded tubular material wherever possible.
1. Minimum Service Temperature: -40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.10 JACKETS

A. PVC Plastic.
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.

b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic:
   a. Compatible with insulation.

B. ABS Plastic:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: -40 degrees F.
   b. Maximum Service Temperature of 180 degrees F.
   c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
   d. Thickness: 30 mil.
   e. Connections: Brush on welding adhesive.

C. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive:
   a. Compatible with insulation.

D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

E. Stainless Steel Jacket: ASTM A666, Type 302 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

A. PIPING INSULATION SCHEDULES
   1. General: Abbreviations used in the following schedules include:
      a. Field Applied Jackets: P - PVC, K-Foil and Paper, A - Aluminum, SS - Stainless Steel.
      b. Piping Sizes: NPS - Nominal Pipe Size.

B. INTERIOR PIPING APPLICATION SCHEDULE
   1. Service: Condensate drain piping.
      a. Operating Temperature: 35 to 75 deg F.
      b. Insulation Material: Flexible elastomeric.
      c. Insulation Thickness: 0.5 inch.
      d. Jacket: None.

e. Vapor Retarder Required: Yes.
f. Finish: None.

2. Service: Heating hot-water supply and return.
   a. Operating Temperature: 100 to 250 deg F.
   b. Insulation Material: Mineral fiber or glass fiber.
   c. Insulation Thickness: Apply the following insulation thicknesses:
      1) Pipe, 1" or less: 1.0 inch.
      2) Pipe, 1-1/4" to 4": 1.5 inch.
      3) Pipe, 5" and up: 2.0 inch.
   d. Jacket: PVC.
   e. Vapor Retarder Required: No.
   f. Finish: None.

C. BURIED PIPING INSULATION SCHEDULE
   1. Pre-insulated piping system as specified in section 23 21 13.

END OF SECTION

SECTION 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermostats, Temperature Sensors.

B. Automatic dampers.

C. Control valves.

D. Damper operators.

E. Time clocks.

F. Miscellaneous accessories.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, gage taps.

B. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.

C. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

D. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

A. Input/Output Sensors:

B. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

D. ASTM B32 - Standard Specification for Solder Metal.

E. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

F. ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating

size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

D. Manufacturer's Instructions: Provide for all manufactured components.

E. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.

F. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

G. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.

H. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

B. NEMA 250, general purpose utility enclosures with enamelled finished face panel.

C. Provide common keying for all panels.

2.03 CONTROL VALVES

A. Ball Valves and Actuators:
   1. Service: Use for brine (30 percent glycol), chilled water, hot water, or steam at 15 to 25 psig (104.4 to 172.4).
   2. Flow Characteristic: Include 2-way and 3-way diverting operation configured to fail normally closed (NC).
   3. Replacements in Kind: Provide pressure-independent type.
   4. Rangeability: 500 to 1.
   5. ANSI Rating: Class 150.

6. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
7. Body Size:
   a. Under 2-1/2 inches:
      1) Connection: NPT.
      2) Materials:
         (a) Body: Brass.
         (b) Flanges: Ductile iron.
         (c) Ball: Chrome-plated brass.
         (d) Stem: Nickel-plated brass.
         (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
         (f) Stem Seal: EPDM O-Rings.
         (g) Flow Control Disk: Thermoplastic synthetic-resin.
   b. 2-1/2 inches and Above:
      1) Connection Type: Flanged.
      2) Materials:
         (a) Body: Brass.
         (b) Flanges: Ductile iron.
         (c) Ball: 300 series stainless steel.
         (d) Stem: 300 series stainless steel.
         (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
         (f) Stem Seal: EPDM O-Rings.
         (g) Flow Control Disk: Thermoplastic synthetic-resin.
   c. Service Temperature:
      1) Fluid Side: 0 to 284 degrees F liquid or 25 psig steam.
      2) Ambient Side: From minus 4 to 122 degrees F.
8. Actuator Requirements:
   a. Assembly: Factory-mounted.
   b. Input: 0 to 5 VDC configured for proportional control.
   c. Accessories: Provide with valve position indicator and manual override.

2.04 DAMPERS

A. Performance: Test in accordance with AMCA 500-D.

B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage.

C. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, attached to minimum 1/2 inch shafts with set screws.

D. Blade Seals: Synthetic elastomeric inflatable mechanically attached, field replaceable.

E. Jamb Seals: Spring stainless steel.

F. Shaft Bearings: Oil impregnated sintered bronze.

G. Linkage Bearings: Oil impregnated sintered bronze.

H. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.

I. Maximum Pressure Differential: 6 inches wg.

J. Temperature Limits: -40 to 200 degrees F.

2.05 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.

1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
2. Provide one operator for maximum 36 sq ft damper section.

B. Electric Operators:
1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

2.06 INPUT/OUTPUT SENSORS

A. Temperature Sensors:
1. Sensor range shall provide a resolution of no worse than .4°F (unless noted otherwise).
2. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for each square foot of cooling coil face area. Temperature range as required for resolution indicated in paragraph A.
   a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
3. Liquid immersion temperature sensor shall include stainless steel thermowell, sensor and connection head for wiring connections.
   a. Sensing element for non-chilled water applications - Platinum RTD, +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F.

B. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

C. Equipment Operation Sensors:
1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

2.07 THERMOSTATS

A. Electric Room Thermostats:
1. Manufacturers:
   a. Honeywell Redlink.
2. Type: NEMA DC 3, 24 voltsprogrammable, wifi-enabled, wall-mounted smart thermostat with setpoint and actual temperature display..
3. Service: heating only.

B. Line Voltage Thermostats:
1. Integral manual On/Off/Auto selector switch, single or two pole as required.
2. Dead band: Maximum 2 degrees F.
3. Cover: Locking with set point adjustment, with thermometer.
4. Rating: Motor load.

C. Electric High Limit Duct Thermostat:
1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
2. Bulb length: Minimum 20 feet.
3. Provide one thermostat for every 20 sq ft of coil surface.

D. Fire Thermostats:

1. UL labeled, factory set in accordance with NFPA 90A.
2. Normally closed contacts, manual reset.

2.08 TIME CLOCKS

A. Wifi enabled, seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.

2.09 TRANSMITTERS

A. Pressure Transmitters:
   1. One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches, CO2 sensors, and humidistats. Refer to Section 26 27 26.

C. Mount freeze protection thermostats using flanges and element holders.

D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Provide separable sockets for liquids and flanges for air bulb elements.

F. Provide thermostats in aspirating boxes in front entrances, gymnasiums, high security areas, and where indicated.

G. Provide guards on thermostats in entrance vestibules, gymnasiums, and corridors..

H. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.

I. Provide isolation (two position) dampers of parallel blade construction.

J. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

K. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same

equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

L. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

M. Provide conduit and electrical wiring in accordance with Section 26 27 17.

3.03 MAINTENANCE

A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide service and maintenance of control system for two years from Date of Substantial Completion.

C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

THE MECHANICAL CONTRACTOR SHALL PROVIDE ALL NECESSARY LABOR MATERIALS TO PROVIDE A FULLY FUNCTIONAL CONTROL SYSTEM FOR THE PROJECT. THIS INCLUDES ALL CONTROL COMPONENTS, CONTROLLERS, WIRING, PROGRAMMING, AND COORDINATION BETWEEN TRADES TO ACCOMPLISH THE SEQUENCE OF OPERATIONS HEREIN. CONTRACTOR SHALL ENSURE THAT ALL COMPONENTS ARE COORDINATED BETWEEN EQUIPMENT SUPPLIERS AND CONTROLS VENDOR FOR ALL EQUIPMENT.

1.01 PART 1 GENERAL

1.02 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
   1. Hot Water Generation
   2. Electric Radiation
   3. Unit Heaters
   4. Energy Recovery Ventilators

1.03 RELATED SECTIONS

A. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

B. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.04 SYSTEM DESCRIPTION

A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
   1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
   2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
   3. Include at least the following sequences:
      a. Start-up.
      b. Warm-up mode.
      c. Normal operating mode.
      d. Unoccupied mode.
      e. Shutdown.
      f. Capacity control sequences and equipment staging.
      g. Temperature and pressure control, such as setbacks, setups, resets, etc.
      h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
      i. Effects of power or equipment failure with all standby component functions.
      j. Sequences for all alarms and emergency shut downs.

k. Seasonal operational differences and recommendations.
l. Interactions and interlocks with other systems.

4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
6. Include schedules, if known.

C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
1. Label with settings, adjustable range of control and limits.
2. Include flow diagrams for each control system, graphically depicting control logic.
3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
5. Include all monitoring, control and virtual points specified in elsewhere.
6. Include a key to all abbreviations.

D. Points List: Submit list of all control points indicating at least the following for each point.
1. Name of controlled system.
2. Point abbreviation.
3. Point description; such as dry bulb temperature, airflow, etc.
4. Display unit.
5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.

E. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.06 QUALITY ASSURANCE

A. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State in which the Project is located.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 HEATING WATER SYSTEM

A. General
1. The heating water system shall be manually enabled and disabled from the boiler's factory control system.

B. Condensing Boiler
   1. The boiler shall be enabled / disabled based on manual operator command. Once enabled, the boiler's integrated combustion controls and integral thermostat shall cycle the boiler and firing rates to maintain the designated loop temperature per the reset schedule.
   2. When the boiler is enabled, its associated circulator pump shall run continuously. Operation of the circulator pump must be proven via a flow switch before the boiler is allowed to fire. An alarm shall be activated if pump operation is not detected when pump is commanded to operate.
   3. The system shall monitor a general failure alarm and a low water cut off alarm from each boiler.

C. Process Loop - Heating mode
   1. When the heating system is enabled via manual operator command, the designated lead pump shall run continuously.
   2. On a loss of flow, as indicated by a differential pressure switch, a "heating water loop failure" shall be indicatedl.

D. Heating Water System Monitoring - The following points shall be monitored:
   1. Process Loop Supply Temperature (Each Sub Loop)
   2. PRocess Loop Return Temperature (Each Sub Loop)
   3. Boiler Loop Supply Temperature
   4. Boiler Loop Return Temperature
   5. Boiler temperature setpoint
   6. Boiler Status Contacts
      a. Boiler Alarm Contacts
   7. Boiler low water cut off
   8. Process Loop Circulator and recirculator pump(s) status via current switch
   9. Process Loop pump flow status via differential pressure switch

3.02 ELECTRIC RADIATION

A. The electric radiation controlled by independent temperature sensors mounted within the space being served. The unit shall be energized and de-energized modulate to maintain temperature within the space (70 °F, user adjustable).

B. When the HVAC system is in cooling mode, the unit shall be de-energized.

C. The following items shall be displayed at the terminal / thermostat:
   1. Temperature Setpoint.
   2. Actual space temperature.
   3. Commanded status of unit (on/off).

3.03 UNIT HEATERS

A. Single temperature electric room thermostat maintains constant space temperature of 68 degrees F by cycling unit fan motor and electricl heating element.

3.04 ENERGY RECOVERY VENTILATORS (ERV)

A. Supply air units and ERV's shall be scheduled for occupied and unoccupied cycles based on an operator adjustable time schedule. Units may also be manually enabled and disabled at the timeclock.

B. When the heat recovery unit is in the occupied mode the unit shall be energized.
   1. The unit exhaust and outside air isolation dampers shall open.
   2. Provide proof of airflow for each fan and provide fan failure alarms.
   3. Provide temperature indication of the supply and exhaust inlet and leaving air.

4. For units over 2,000 cfm a duct smoke detector shall be provided by the electrical contractor. Provide the interlock wiring to shut down the units upon activation.
5. The electric heating coil shall be energized when required to maintain a minimum discharge air (supply air) temperature of 60 degrees to the units.

C. The following items shall be availalbe for troubleshooting:
1. Discharge temperature.
2. Return air temperature.
3. Outside air temperature, humidity and enthalpy.
4. Fan operational status via current sensor.
5. Commanded status of fan.
6. Commanded status of heating coils (as applicable).
7. Commanded position of dampers.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements (Chilled water, hot water, dual temperature)

B. Heating water piping, above grade.

C. Pipe and pipe fittings for:
   1. Hot water piping system.
   2. Equipment drains and overflows.

D. Pipe hangers and supports.

E. Unions, flanges, mechanical couplings, and dielectric connections.

F. Valves:
   1. Gate valves.
   2. Globe or angle valves.
   3. Ball valves.
   4. Plug valves.
   5. Butterfly valves.
   6. Check valves.

G. Flow controls.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 08 31 00 - Access Doors and Panels.

C. Section 09 90 00 - Painting and Coating.

D. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.

E. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

F. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

G. Section 22 07 19 - Plumbing Piping Insulation.

H. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

I. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

J. Section 23 05 48 - Vibration and Seismic Con. for Equipment.

K. Section 23 05 53 - Identification for HVAC Piping and Equipment.

L. Section 23 07 19 - HVAC Piping Insulation.

M. Section 23 21 14 - Hydronic Specialties.

N. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.

O. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

F. ASME B31.9 - Building Services Piping.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.

H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers.

I. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.9).

J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

L. ASTM B32 - Standard Specification for Solder Metal.

M. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

P. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

Q. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

R. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

S. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

T. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

U. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

V. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

W. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.

X. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

Y. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

Z. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.

AA. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.

AB. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.

AC. AWS D1.1/D1.1M - Structural Welding Code - Steel.

AD. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).

AE. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

AF. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

AG. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.04 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use grooved mechanical couplings and fasteners in accessible locations.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Use non-conducting dielectric connections whenever jointing dissimilar metals.

E. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

F. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

G. Use globe or ball valves for throttling, bypass, or manual flow control services.

H. Use spring loaded check valves on discharge of condenser water pumps.

I. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

J. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

K. Use lug end butterfly valves to isolate equipment.

L. Use 3/4 inch gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

M. GROOVED MECHANICAL COUPLINGS MAY NOT BE USED ON THIS PROJECT.

1.05 SUBMITTALS

A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

B. Welders Certificate: Include welders certification of compliance with ASME (BPV IX).

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Project Record Documents: Record actual locations of valves.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.

C. Welder Qualifications: Certify in accordance with ASME (BPV IX).

1.07 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.10 EXTRA MATERIALS

A. Provide two repacking kits for each size and valve type.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical joints are not permitted in any location.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
   5. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap.

2. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

E. Welding Materials and Procedures: Conform to ASME (BPV IX).

2.02 HEATING WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1 welded.
2. Threaded Joints: ASME B16.3, malleable iron fittings.
3. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
4. Joints: Threaded or AWS D1.1 welded.

B. Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black; using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1 welded.
2. Joints: Welded in accordance with AWS D1.1.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
b. Braze: 1 BCuP copper/silver alloy.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, non toxic synthetic rubber sealing elements.
3. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

2.03 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: Solvent welded in accordance with ASTM D2855.

2.04 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

D. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

F. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

H. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

I. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

K. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

L. Vertical Support: Steel riser clamp.

M. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

O. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

P. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

Q. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

R. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

S. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.05 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Under:
   1. Ferrous Piping: 150 psig malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:
   1. Ferrous Piping: 150 psig forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.

2.06 GATE VALVES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
   1. Bronze body, bronze trim, screwed or union bonnet, non-rising stem, lockshield stem or handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder ends.

C. Over 2 Inches:

1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends.

2.07 GLOBE OR ANGLE VALVES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
   1. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder ends.

C. Over 2 Inches:
   1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.08 BALL VALVES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
   1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

C. Over 2 Inches:
   1. Ductile iron body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, grooved ends or flanged, rated to 800 psi.
   2. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.09 PLUG VALVES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
   1. Bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.
   2. Operator: One plug valve wrench for every ten plug valves minimum of one.

C. Over 2 Inches:
   1. Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.
   2. Operator: Each plug valve with a wrench with set screw.

2.10 BUTTERFLY VALVES

A. Manufacturers:
   1. Hammond Valve: www.hammondvalve.com.
   2. Crane Co.: www.cranevalve.com.

3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, grooved, or _____ ends, extended neck.

C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM enscapsulation, Buna-N enscapsulation, or _____.

D. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

E. Disc: Aluminum bronze.

F. Operator: 10 position lever handle.

2.11 SWING CHECK VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

C. Over 2 Inches:
1. Iron body, bronze or _____ trim, stainless steel, bronze, bronze faced rotating, or _____ swing disc, renewable disc and seat, flanged, grooved, or _____ ends.
2. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.12 SPRING LOADED CHECK VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.13 FLOW CONTROLS

A. Manufacturers:
1. Griswold Controls:
2. Taco, Inc:
3. Tour and Andersson
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, chilled water, dual-temperature, and condenser water piping to ASME B31.9 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls and floors.

H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

I. Slope piping and arrange to drain at low points.

J. For buried piping, trenches shall be backfilled and hand tamped in 6" layers until a cover of at least 24" from the top of the pipe has been achieved. The first 12" of backfill shall be sand or fine gravel of less than 1/2" diameter. The remainder of the backfill shall be void of rocks, frozen earth, and foreign material of over 4" in diameter. The trench shall be compacted to comply with H-20 highway loading.

K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.

M. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

N. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

O. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

P. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

Q. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.

R. Use eccentric reducers to maintain top of pipe level.

S. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

T. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.

U. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. 3 inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. 4 inch: Maximum span, 12 feet; minimum rod size, 1/2 inch.
7. 6 inch: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 8 inch: Maximum span, 16 feet; minimum rod size, 5/8 inch.
9. 10 inch: Maximum span, 18 feet; minimum rod size, 3/4 inch.
10. 12 inch: Maximum span, 19 feet; minimum rod size, 7/8 inch.

B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.

10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.
14. 18 inches: Maximum span, 28 feet; minimum rod size, 1-1/4 inch.
15. 20 inches: Maximum span, 30 feet; minimum rod size, 1-1/4 inch.

C. Hanger Spacing for Plastic Piping.
1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
6. 2 inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.
7. 3 inches: Maximum span, 7 feet; minimum rod size, 3/8 inch.
8. 4 inches: Maximum span, 8 feet; minimum rod size, 1/2 inch.
9. 6 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
10. 8 inches: Maximum span, 11 feet; minimum rod size, 5/8 inch.
11. 10 inches: Maximum span, 13 feet; minimum rod size, 3/4 inch.
12. 12 inches: Maximum span, 14 feet; minimum rod size, 7/8 inch.
13. 14 inches: Maximum span, 15 feet; minimum rod size, 1 inch.
14. 16 inches: Maximum span, 16 feet; minimum rod size, 1 inch.
15. 18 inches: Maximum span, 18 feet; minimum rod size, 1-1/4 inch.

END OF SECTION

SECTION 23 21 14
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.
B. Expansion tanks.
C. Air vents.
D. Strainers.
E. Suction diffusers.
F. Combination pump discharge valves.
G. Balancing valves.
H. Combination flow controls.
I. Flow meters.
J. Pump suction fittings.
K. Combination fittings.
L. Flow indicators, controls, meters.
M. Radiator valves.
N. Relief valves.

1.02 RELATED REQUIREMENTS

A. Section 22 10 06 - Plumbing Piping Specialties: Backflow Preventers.
B. Section 23 21 13 - Hydronic Piping.
C. Section 23 25 00 - HVAC Water Treatment: Pipe Cleaning.

1.03 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model.
C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
E. Project Record Documents: Record actual locations of flow controls and flow meters.
F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 EXTRA MATERIALS

A. See Section 01 6000 - Project Requirements, for additional provisions.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com/#sle.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Taco, Inc: www.taco-hvac.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psi.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.02 AIR VENTS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Taco, Inc: www.taco-hvac.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
   2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:
   1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.03 STRAINERS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. Green Country Filtration: greencountryfiltration.com.
   3. WEAMCO: www.weamco.com.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Size 2 inch and Under:
1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:
1. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:
1. Flanged iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.04 SUCTION DIFFUSERS

A. Manufacturers:
1. ITT Bell & Gossett: www.bellgossett.com/#sle.
2. Anvil International, Inc: www.anvilintl.com.
3. Victaulic Company of America: www.victaulic.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

C. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

D. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.05 COMBINATION PUMP DISCHARGE VALVES

A. Manufacturers:
1. Crane Co.: www.cranevalve.com/#sle.
2. Taco, Inc: www.taco-hvac.com/#sle.
3. Victaulic Company of America: www.victaulic.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.06 BALANCING VALVES

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. ITT Bell & Gossett: www.bellgossett.com/#sle.
3. Taco, Inc: www.taco-hvac.com/#sle.
4. Tour and Andersson: www.tahydronics.com

B. Size 2 inch and Smaller:
1. Provide globe or _____ style with flow balancing, flow measurement, 3/4" NPT hose end drain connection, and full shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
2. Metal construction materials consist of bronze, brass, or Ametal.
3. Non-metal construction materials consist of EPDM.

C. Size 2.5 inch and Larger:
   1. Provide globe style with flow balancing, flow measurement, 3/4" NPT hose end drain connection, and full shut-off capabilities and flanged, grooved, or weld end connections.
   2. Valve body construction materials consist of ductile iron.
   3. Internal components construction materials consist of brass, bronze, EPDM, or Ametal.

2.07 COMBINATION FLOW CONTROLS

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Cla-Val Co: www.cla-val.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.08 FLOW METERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. EMCO Flow Systems: www.emcoflow.com/#sle.
   3. GE Infrastructure Sensing/GE Panametrics: www.gesensing.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Orifice principle by-pass circuit with direct reading gage, soldered or flanged piping connections for 125 psi working pressure, with shut off valves, and drain and vent connections.

C. Direct reading with insert pitot tube, threaded coupling, for 150 psi working pressure, maximum 240 degrees F, 5 percent accuracy.

D. Cast iron, wafer type, orifice insert flow meter for 250 psi working pressure, with read-out valves equipped with integral check valves with gasketed caps.

E. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

F. Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and gasketed caps.

G. Portable meter consisting of case containing one, 3 percent accuracy pressure gage with 0-60 feet pressure range for 500 psi maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

H. Portable meter consisting of case containing two, 3 percent accuracy pressure gages with 0-135 inches and 0-60 feet pressure ranges for 500 psi maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.09 RADIATOR VALVES

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.

2. ITT Bell & Gossett: www.bellgossett.com/#sle.
3. Myson, Inc: www.mysoninc.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psi working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

2.10 RELIEF VALVES

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. ITT Bell & Gossett: www.bellgossett.com/#sle.
3. Conbraco Industries, Inc: www.conbraco.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps . Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps .

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.

K. Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.

L. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

M. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

N. Pipe relief valve outlet to nearest floor drain.

O. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. In-line circulators.

B. Vertical in-line pumps.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.

C. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

D. Section 22 07 19 - Plumbing Piping Insulation.

E. Section 22 07 16 - Plumbing Equipment Insulation.

F. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

G. Section 23 05 48 - Vibration and Seismic Con. for Equipment.

H. Section 23 07 16 - HVAC Equipment Insulation.

I. Section 23 07 19 - HVAC Piping Insulation.

J. Section 23 21 13 - Hydronic Piping.

K. Section 23 21 14 - Hydronic Specialties.

L. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators.

B. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. NFPA 70 - National Electrical Code.

D. UL 778 - Standard for Motor-Operated Water Pumps.

1.04 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Millwright's Certificate: Certify that base mounted pumps have been aligned.

E. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright.

1.07 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.08 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Provide one set of mechanical seals for each pump.

C. Provide 2 sets of cartridges for each side-stream filter.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ITT Bell & Gossett: www.bellgossett.com/#sle.

2.02 HVAC PUMPS - GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.

2.03 SYSTEM LUBRICATED CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, for 140 psi maximum working pressure, 230 degrees F maximum water temperature.

B. Casing: Cast iron with flanged pump connections.

C. Impeller, Shaft, Rotor: Stainless Steel.

D. Bearings: Metal Impregnated carbon (graphite) and ceramic.

E. Motor: Impedance protected, multiple speed, with external speed selector.

2.04 IN-LINE CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi maximum working pressure.

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psi maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Cadmium plated steel, Stamped brass or cast bronze, Non-ferrous, Bronze, Cast bronze, or Stamped brass, keyed to shaft.

E. Bearings: Oil-lubricated bronze sleeve or Permanently-lubricated ball bearings.

F. Shaft: Alloy steel or Stainless steel with copper or bronze sleeve, integral thrust collar.

G. Seal: Mechanical seal or Carbon rotating against a stationary ceramic seat, viton fitted, 225 degrees F maximum continuous operating temperature.

H. Seal: Mechanical seal or Carbon rotating against a stationary ceramic seat, viton fitted, 275 degrees F maximum continuous operating temperature.

I. Drive: Flexible coupling.

2.05 VERTICAL IN-LINE PUMPS

A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psi working pressure.

B. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze or Cast iron, fully enclosed, keyed directly to motor shaft or extension.

D. Shaft: Carbon steel or Stainless steel with stainless steel impeller cap screw or nut and bronze sleeve.

E. Seal: Mechanical seal, Carbon rotating against a stationary ceramic seat, or Manufacturer's standard seal, 225 degrees F maximum continuous operating temperature.

F. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 250 degrees F maximum continuous operating temperature.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Refer to Section 23 05 48.

D. Provide line sized shut-off valve and strainer or pump suction fitting on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Check, align, and certify alignment of base mounted pumps prior to start-up.

H. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 30 00.

I. Lubricate pumps before start-up.

J. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tappings.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Casing and plenums.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 09 90 00 - Painting and Coating: Weld priming, weather resistant, paint or coating.

C. Section 11 40 00 - Foodservice Equipment: Supply of kitchen range hoods for placement by this Section.

D. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

E. Section 23 33 00 - Air Duct Accessories.

F. Section 23 36 00 - Air Terminal Units.

G. Section 23 37 00 - Air Outlets and Inlets.

H. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

H. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.

I. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, Culvert Pipe (Metric).

J. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

K. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

M. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

N. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.

P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

Q. SMACNA (FGD) - Fibrous Glass Duct Construction Standards.

R. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

S. IECC 2012 - International Energy Conservation Code - Duct construciton standards, leakage testing

1.04 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

D. MANDATORY Test Reports: Pressure test all ductwork. Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

1. Utilize standard equation CL=FP^0.65 where F= Measured leakage rate in CFM per 100 square feet of duct surface, and P = Static Pressure of the test. Leakage rate shall not exceed 4.0 in that equation.

E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.

F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.07 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.

1.08 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

C. Stainless Steel for Ducts: ASTM A 240/A 240M, Type 304.

D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

E. Flexible Ducts:
   1. Two ply vinyl film supported by helically wound spring steel wire.
      a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
      b. Maximum Velocity: 4000 fpm.
      c. Temperature Range: -10 degrees F to 160 degrees F.

F. Insulated Flexible Ducts:
   1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
      a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
      b. Maximum Velocity: 4000 fpm.
      c. Temperature Range: -10 degrees F to 160 degrees F.

G. Stainless Steel Ducts: ASTM A 666, Type 304.

H. All Ducts: Galvanized steel, unless otherwise indicated.

I. Low Pressure Supply (Heating Systems): 1 inch w.g. pressure class, galvanized steel.

J. Low Pressure Supply (System with Cooling Coils): 1 inch w.g. pressure class, galvanized steel.

K. Medium and High Pressure Supply (All VAV Primary Supply Duct between AHU and VAV Terminal Unit): 2 inch w.g. pressure class, galvanized steel.

L. Return and Relief: 1 inch w.g. pressure class, galvanized steel.

M. General Exhaust: 1 inch w.g. pressure class, galvanized steel.

N. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.

O. Grease Exhaust: 1 inch w.g. pressure class, stainless steel.
   1. Construct of 18 gage stainless steel.
   2. Construction:
      a. Liquid tight with continuous external weld for all seams and joints.
      b. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
   3. Access Doors:
      a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.

b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.

4. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide turning vanes. .

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.

F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages,reinforcing, and sealing for operating pressures indicated.

B. Double Wall Insulated Round Ducts: Round spiral lockseam duct with paintable galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall. Provide paint in color selected by architect.
   1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards.
   2. Insulation:
      a. Thickness: 2 inch, Minimum R-6.
      b. Material: Fiberglass, with mylar coating between insulation and perforated liner.

C. Double Wall Insulated Rectangular Ducts: Rectangular spiral lockseam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Insulation:
      a. Thickness: 2 inch, minimum R-6.
      b. Material: Fiberglass, with mylar coating between insulation and perforated liner.

D. Transverse Duct Connection System: SMACNA "J" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
   1. Manufacturers:

2.05 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards and construct for operating pressures indicated.

B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

C. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

D. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
   1. Provide clear wire glass observation ports, minimum 6 X 6 inch size.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide flexible duct connectors at all motorized equipment.

B. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.

C. Install in accordance with manufacturer's instructions.

D. Kitchen Hood Exhaust: Provide residue traps at base of vertical risers with provisions for clean out.

E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

G. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

I. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

J. Use double nuts and lock washers on threaded rod supports.

K. Tape joints of PVC coated metal ductwork with PVC tape.

L. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

M. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

O. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

P. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.

Q. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

R. At exterior wall louvers, seal duct to louver frame and install blank-out panels as required.

3.02 CLEANING AND TESTING

A. Conduct required duct-leakage testing for all ductwork as defined within this specification and otherwise noted in the contract documents.

3.03 SCHEDULES

A. Ductwork Material:
   1. Low Pressure Supply (Heating Systems): Steel, Aluminum.
   2. Low Pressure Supply (System with Cooling Coils): Steel, Aluminum.
   3. Medium and High Pressure Supply: Steel.
   4. Return and Relief: Steel, Aluminum.
   5. General Exhaust: Steel, Aluminum.
   6. Kitchen Hood Exhaust: Stainless Steel.
   7. Dishwasher Exhaust: Stainless Steel.
   8. Outside Air Intake: Steel.
   9. Exposed round ductwork: Double-walled spiral.

B. Ductwork Pressure Class:
   1. Supply (Heating Systems): 1 inch
   2. Supply (System with Cooling Coils): 2 inch.
   3. Return and Relief: 1 inch.
   4. General Exhaust: 1 inch.
   5. Outside Air Intake: 2 inch.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.
B. Backdraft dampers.
C. Duct access doors.
D. Duct test holes.
E. Flexible duct connections.
F. Smoke dampers.
G. Volume control dampers.

1.02 RELATED REQUIREMENTS

A. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
B. Section 23 31 00 - HVAC Ducts and Casings.
C. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
B. NFPA 92 - Standard for Smoke Control Systems.
C. NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service.
F. UL 555 - Standard for Fire Dampers.
G. UL 555S - Standard for Smoke Dampers.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.05 PROJECT RECORD DOCUMENTS

A. Record actual locations of access doors and test holes.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

1.08 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Provide two of each size and type of fusible link.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
   1. Krueger: www.krueger-hvac.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. Titus: www.titus-hvac.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS

A. Manufacturers:
   1. Louvers & Dampers, Inc: www.louvers-dampers.com/#sle.
   2. Nailor Industries Inc: www.nailor.com/#sle.
   3. Ruskin Company: www.ruskin.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.03 DUCT ACCESS DOORS

A. Manufacturers:
   1. Nailor Industries Inc: www.nailor.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. SEMCO Incorporated: www.semcoinc.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
   1. Less Than 12 inches Square: Secure with sash locks.
   2. Up to 18 inches Square: Provide two hinges and two sash locks.
   3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
   4. Larger Sizes: Provide an additional hinge.

D. Access doors with sheet metal screw fasteners are not acceptable.

2.04 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.05 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
      a. Net Fabric Width: Approximately 6 inches wide.
   2. Metal: 3 inches wide, 24 gage thick galvanized steel.

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.06 VOLUME CONTROL DAMPERS

A. Manufacturers:
   1. Louvers & Dampers, Inc: www.louvers-dampers.com/#sle.
   2. Nailor Industries Inc: www.nailor.com/#sle.
   3. Ruskin Company: www.ruskin.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

C. Splitter Dampers:
   1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
   2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .

D. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 00 for duct construction and pressure class.

B. Provide access doors at any location where dampers are concealed above inaccessible ceilings.

C. Provide flexible duct connectors at expansion joints and at all connections to motorized equipment.

D. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

E. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

F. Provide duct test holes where indicated and required for testing and balancing purposes.

G. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

H. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
   1. Smoke dampers shall be integrated into the "smoke purge control system". Dampers in the return ductwork shall be overridden to the open position when the smoke purge is activated.

I. Demonstrate re-setting of fire dampers to Owner's representative.

J. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

K. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 22 05 48.

L. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

M. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

N. Use splitter dampers only where indicated.

O. Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 36 00 - Air Terminal Units.

P. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Registers/grilles.
   1. Ceiling-mounted, exhaust and return register/grilles.
B. Louvers.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.
B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute.
C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
C. Samples: Submit one of each required air outlet and inlet type.
D. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
B. Test and rate louver performance in accordance with AMCA 500-L.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.

1.07 MOCK-UP

A. Provide mock-up of typical exterior or exterior ceiling module with supply and return air outlets.
B. Locate where directed.
C. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carnes Company HVAC: www.carnes.com.
B. Krueger: www.krueger-hvac.com/#sle.
C. Price Industries: www.price-hvac.com/#sle.
D. Titus: www.titus-hvac.com/#sle.
E. Tuttle and Bailey: www.tuttleandbailey.com.
F. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, horizontal face.

B. Frame: 1 inch margin with countersunk screw mounting.

C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, or prime coated finish as indicated on drawings or selected by architect.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.03 LOUVERS

A. Type: 4 inch or 6 inch deep as indicated on drawings with blades on 45 degree slope , heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.

B. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory prime coat, baked enamel, anodized or fluoropolymer spray finish as indicated on drawings or selected by architect.

C. Mounting: Furnish with exterior angle flange, screw holes in jambs or masonry strap anchors for installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 90 00.

3.02 AIR OUTLET AND INLET SCHEDULE

A. See Drawings

END OF SECTION

SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured breechings.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 22 07 16 - Plumbing Equipment Insulation.

C. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Induced draft fan motor.

D. Section 23 07 16 - HVAC Equipment Insulation.

E. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances.

B. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.

C. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

D. ASME B31.9 - Building Services Piping.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

F. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping.

G. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

H. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

L. ASTM C401 - Standard Classification of Alumina and Alumina-Silicate Castable Refractories.

M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

N. NEMA MG 1 - Motors and Generators.

O. NFPA 31 - Standard for the Installation of Oil Burning Equipment.

P. NFPA 54 - National Fuel Gas Code.

Q. NFPA 70 - National Electrical Code.

R. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment.

S. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
T. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
U. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
V. UL 127 - Standard for Factory-Built Fireplaces.
W. UL 378 - Standard for Draft Equipment.
X. UL 641 - Type L Low Temperature Venting Systems.
Y. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.04 DEFINITIONS

A. Breeching: Vent Connector.
B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
C. Smoke Pipe: Round, single wall vent connector.
D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of breeching and venting with size, location and installation of service utilities.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.07 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.

1.08 QUALITY ASSURANCE

A. Designer Qualifications: Design stacks under direct supervision of a Professional Structural Engineer experienced in design of the type of work specified and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.09 REGULATORY REQUIREMENTS

A. Conform to applicable code for installation of natural gas burning appliances and equipment.

B. Conform to NFPA 31 for installation of oil burning appliances and equipment.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pro Tech; Model FasNSeal: www.ampcostacks.com.

B. Metal-Fab, Inc; Model Corr / Guard: www.mtlfab.com/#sle.

C. Selkirk Corporation; Model Saf T Vent: www.selkirkcommercial.com/#sle.

2.02 MANUFACTURED BREECHINGS

A. Provide factory-built AL29-4C, manufacturered breeching and venting system, tested to UL UL-1738 with positive pressure rating. Include locking band and integral gasket for a factory-approved assembled system.

B. Assembly to be UL listed for use with building equipment in compliance with NFPA 211.

C. Size in accordance with equipment manufacturer's recommendations and fabricator requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards for equivalent duct support configuration and size.

E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

F. Insulate breechings in accordance with Section 23 07 16.

G. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

H. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

END OF SECTION

SECTION 23 52 33.18
CONDENSING HEATING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Boilers.

B. Controls and boiler trim.

C. Hot water connections.

D. Fuel connection.

E. Collector, draft hood, and chimney connection.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 23 21 14 - Hydronic Specialties.

C. Section 23 51 00 - Breechings, Chimneys, and Stacks.

D. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

E. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCES

A. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2004 (addendum 2005).

B. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2004.

C. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2004.

D. HI BTS - Testing and Rating Standard for Commercial Boilers; The Hydronics Institute; 2000.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2003.

F. NFPA 31 - Standard for the Installation of Oil Burning Equipment; National Fire Protection Association; 2006.

G. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2006.

H. NFPA 58 - Liquefied Petroleum Gas Code; National Fire Protection Association; 2004.

I. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

J. UL 726 - Oil-Fired Boiler Assemblies; Underwriters Laboratories Inc.; 1995.

K. UL (HCVCE) - Heating, Cooling, Ventilating and Cooking Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 PERFORMANCE REQUIREMENTS

A. Performance rating shall be in accordance with Hydronics Institute Testing and Rating Standard for Commercial Boilers.

B. Rating: As scheduled.

1.05 SUBMITTALS

A. See Section Gilbane Project Manual for requirements.

B. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

C. Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in City of Providence's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. The boiler manufacturer shall coordinate with the Owner-designated controls contractor to ensure that all required interface equipment, controllers, sensors, actuators, relays, etc. are accounted for (both devices and installation thereof) prior to bid submission.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 5 years of documented experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable code or NFPA 70 code for internal wiring of factory wired equipment.

B. Conform to ASME (BPV IV) and (BPV VIII, 1) and UL 726 for boiler construction.

C. Units: AGA certified.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.09 WARRANTY

A. Provide 10 year warranty on for heat exchanger and fuel burner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Veissmann: www.veissmann-us.com.

B. Lochinvar: www.lochinvar.com.

C. RBI: www.rbiwaterheaters.com

D. Substitutions: Not Permitted.

2.02 MANUFACTURED UNITS

A. Hot Water Boilers: Factory packaged low pressure condensing hot water boilers of the size and efficiency indicated, complete with all components, accessories, and appurtenances necessary for a complete and operable boiler as specified and designated on the drawings. Each unit shall be factory assembled with required wiring and piping as a self-contained unit.

B. Each factory packaged boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, appurtenances, and accessories as specified shall be assembled and furnished by the manufacturer. The manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory package boiler specified herein. The boiler manufacturer shall bear full responsibilities for all components assembled and furnished by him whether or not they are of his own manufacture.

C. All units shall be factory fire-tested under simulated operating conditions. A run-test report, including air and fuel settings, shall be permanently affixed to the boiler prior to shipping to the site.

2.03 FABRICATION

A. Assembly: Horizontal, stainless steel heat exchanger complete with trim, valve trains, burner, and boiler control system. Manufacturer shall full coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

B. Each boiler heat exchanger shall be cast aluminum or stainless steel, counter flow design for maximum heat transfer.

C. Contractor must verify that that PH level is maintained between 6.0 and 8.5 when filling the system.

D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped. Entire assembly shall be fabricated to meet the local CSD-1 code requirements for the State of Delware, City of Seaford.

E. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 degree F service. Push nipples or section gaskets are not acceptable.

F. Boilers shall be enclosed with a single wall outer casing. It shall be fabricated from a minimum 16 gage carbon steel. The complete outer casing shall be powder-coated inside and out. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure and outer casing temperature of not more than 50 degrees F above ambient temperature when the boiler is operating at full load.

G. An observation port shall be located on the boiler to observe flame condition.

H. Flue gas outlet shall be located at the rear of the boiler and be certified for installation with Category IV venting as defined by NFPA 54 (ANSI Z221), latest edition.

2.04 HOT WATER BOILER TRIM

A. ASME rated pressure relief valve, 30 psig.

B. Combination water pressure and temperature gage.

C. Low water cut-off to prevent burner operation when boiler water falls below safe level (probe type with manual reset).

D. Operating temperature controller with outdoor reset to control the sequential operation of the burner.

E. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.

F. Separate inlet and outlet water temperature sensors capable of monitoring flow.

G. Exhaust temperature sensor.

2.05 FUEL BURNING SYSTEM

A. The manufacturer shall furnish each boiler with an integral, power type, straight gas or LP/Propane, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements the boiler heat exchanger and boiler control system to provide the required capacities, efficiencies, and performance as specified.

B. Boilers shall be set to run for LP/Propane for this installation.

C. Each burner shall be provided with an integral gas firing combustion head.

D. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gasses.

E. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel with the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. The static and total pressure capability shall comply with the requirements of the boiler. The blower shall be designed and constructed for exposure to temperatures normal to its location on the boiler and shall operate without undue vibration and noise. The operating fan will be tachometer sensed and capable of being displayed on the LED display.

F. Each boiler shall be of the radial-fired (down-fired) type and constructed of steel with a stainless steel inner and stainless steel mesh outer screen.

G. Each boiler shall be provided with a "Fully Modulating" firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse-width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

H. Ignition shall be spark-ignition type. No pilots are allowed.

I. The Micro Processor shall use a Proportional Integral Algorithm to determine the firing rate. The controls shall include:
   1. Maintain single set point
   2. Outdoor air temp reset of setpoint
   3. Boiler shutdown based on outdoor air temp
   4. Internal dual setpoint program with an external switchover (night setback, etc.
      a. from external source)
         1) Alarm relay for any manual reset alarm function.
         2) Programmable Low Fire Delay to prevent short-cycling base on time and
            (a) temperature factor for release to modulation.
         3) LED Display showing current supply an return temps, current setpoints, and
            (a) differential setpoints. Display shall also list any fault-codes whether auto or manual reset in nature.
         4) Local manual operation.
         5) Remote control system (BAS/sequencer) interface – The boiler control shall be
            (a) capable of accepting a 0-10vdc remote external analog signal to control the firing rate.
         6) Computer interface for programming and monitoring all functions.

2.06 MAIN GAS VALVE TRAIN

A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
   1. Two (2) manual shutoff valves
   2. Two (2) safety shutoff valves equipped with dual solenoids that can independently energize for leak testing.
   3. Air-gas ratio control (maximum inlet pressure of 14 WC)
   4. One (1) low-gas pressure switch (manual reset).
   5. One (1) high-gas pressure switch (manual reset).
   6. Two (2) pressure test ports.

2.07 COMBUSTION AIR CONTROL SYSTEM

A. Each boiler shall be provided with an integral combustion air control system. The combustion air control system shall be factory assembled. Each combustion air control system shall include at least the following:
   1. The primary control shall vary the speed of the blower based on the load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, therby increasing or decreasing the firing rate. Both the air and the gas shall be premixed in the blower.
   2. One (1) low airflow differential pressure switch to insure that the combustion air is supplied.
   3. High exhaust back-pressure switch.

2.08 BURNER CONTROL SYSTEM

A. The Burner Control System shall be supplied with a 24 VAC transformer (120/1/60 primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the Motor Control Center.

B. The boiler shall include a spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.

C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

2.09 BOILER CONTROL PANEL

A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
   1. One (1) burner on/off switch.
   2. One (1) electronic combination temperature control, flame safeguard, and system
      a. control.
         1) Control circuit breaker
         2) All necessary control switches, pushbuttons, relays, timers, terminal strips, etc. to
            (a) complete functionality of the control system.
         3) LED display panel to show adjusting setpoints and control parameters. Display
            (a) shall indicate burner sequence, all service codes, fan speed, boiler set point, and all sensor values.

B. Inconnection communication controller to link multiple boilers for sequenced firing coordination (Patterson Kelley ENVI, Heat-Timer Multi-Mod system or equal) capable of:
   1. Controlling multiple boilers in all stages for efficient sequencing of the boiler system.
   2. Receiving input from the building automation system for engagement of the heating system.
   3. Recieving input from the building automation system for outdoor air reset scheduling.
   4. Internal clock-based scheduling for operational control.

2.10 ADDITIONAL INSTALLATION ITEMS

A. The contractor shall provide and install the following items during the boiler installation process:

1. Manufacturer's recommended water treatment chemical additive to maintain heating and dual-temperature water pH between 6.0 and 8.5. Utilize the exisitng pot-feeder system for injection.
2. Manufacturer's required acid-neutralization system to treat condensation prior to release from the boiler room.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in full accordance with manufacturer's instructions.

B. Install boiler on concrete housekeeping base, sized minimum 4 inches larger than boiler base.

C. Provide connection of natural gas service in accordance with requirements of NFPA 54 and all applicable State and Local codes.

D. Provide piping connections and accessories as indicated on drawings and in specifications; refer to Section 23 21 14.

E. Pipe relief valves to nearest floor drain.

F. Install circulator and diaphragm expansion tank on boiler.

G. Provide for connection to electrical service. Refer to Section 26 27 17.

H. Contractor must, when filling the system, verify that the pH is maintained between 6.0 and 8.5.

I. Provide and install acid-neutralization tank at each unit per manufacturer's instructions. Pipe discharge to nearest floor drain.

3.02 MANUFACTURER'S FIELD SERVICES

A. Instruct operating personnel in operation and maintenance of units.

3.03 SCHEDULES

A. See Drawings

END OF SECTION

SECTION 23 72 23
PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged dessicant air-to-air energy recovery units.

B. Duct-Mounted Pre-Heat Coils

1.02 RELATED SECTIONS

A. Section 01 91 00 - Commissioning

B. Section 01 91 10 - Functional Testing Procedures

C. Section 23 08 00 - Mechanical Systems Commissioning

D. Section 23 08 10 - Control Systems Commissioning

E.

1.03 REFERENCE STANDARDS

A. AHRI 1060 I-P - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

C. ASHRAE Std 84 - Method of Testing Air to Air Heat/Energy Exchangers.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. NFPA 70 - National Electrical Code.

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

G. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's installation instruction, product data, and engineering calculations.

C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Firm regularly engaged in manufacturing energy recovery units.
   2. Products in satisfactory use in similar service for not less than five years.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in manufacturer's unopened packaging.

B. Store products to be installed indoors in dry, heated area.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Warranty motor to be free from defects in material and workmanship for 7 years under circumstances of normal use.

C. Warranty dessicant core to be free from defects in material and workmanship for 10 years under circumstances of normal use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Energy Recovery Ventilators:
   1. Renew Aire: www.renewaire.com.
   2. Nu-Air: www.nu-air.com
   3. Innovent: www.innoventair.com
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ENERGY RECOVERY UNITS

A. Energy Recovery Units: Fixed plate cross-flow energy exchange type (hydroscopic resin) type; prefabricated packaged system designed by manufacturer.
   1. Access: Hinged access panels on front. Pressure taps provided.
   2. Lifting holes at the unit base.
   3. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
   4. Permanent name plate listing manufacturer mounted inside door near electrical panel.

2.03 CASING

A. Wall, Floor, and Roof Panels:
   1. Construction: 2 inch thick, double wall box construction, with formed edges of exterior wall overlapping formed edges of interior wall.
   2. Exterior Wall: galvanized steel sheet. or aluminum.
      a. 20 gage galvanized steel,
      b. Color: Gray or white
   3. Interior Wall: Galvanized sheet metal.
      a. 22 gage, 0.0299 inch galvanized sheet metal.
   4. Insulation:
      a. 2 inch insulated fiberglass board insulation.
      b. All insulation sealed with foil/scrim facing leaving no exposed insulation to the airstream.
      c. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
      d. Smoke Developed Index: 50, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
   5. Roof Panel: Weatherproof.
   6. Panel Joints: 20 gauge steel with lapped corners and zinc-plated screws.
   7. Fasteners: Stainless steel.
   8. Isolation and Seal: Form continuous, thermally isolated, weather tight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing.
   9. Seams: Sealed, requiring no caulking at job site.
   10. Coating: Polyurethane enamel. Factory finished in a custom color as selected by the architect.

B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.

C. Doors:
   1. Construct doors of same construction and thickness as wall panels.
   2. Hardware:

a. Corrosion-resistant.

2.04 FANS

A. Provide separate fans for exhaust and supply blowers.

B. Fans:
1. Individually driven with a dedicated motor.
2. AMCA-rated.
3. Provide with non-overloading characteristics.
4. Provide non-sparking integral spun steel venturie inlet cones.

C. Bearings:
1. Pillow block.
2. Bearings: Permanently lubricated sealed ball bearings.
3. Rated for not less than 200,000 hours of operation with accessible greased fittings.

D. Housings: 12 gage, 0.1046 inch aluminized steel with plenums integral to general housing and constructed to Class 1 fan standards.

E. Motors:
1. Motors: ECM direct drive or VFD-driven as scheduled.
2. Efficiency: Premium.
3. Speed: Variable.
4. Control: Variable Frequency Drive.
5. Motor Slide Bases: Removable and adjustable.
6. Fan Motor: Thermal overload protected.
7. Fan Motor: UL listed and labeled.

F. Drives:
1. Fans: Belt driven or direct as scheduled.
2. Sheaves: Variable.
3. Service Factor: 1.2.

G. Belt Guards: Full sized, hinged, painted with high-visibility safety color, and accessible with standard tools.

2.05 TOTAL ENERGY RECOVERY MEDIA

A. Transfer heat and humidity from one air stream to the other with no carryover of the exhaust air into the supply air stream.

B. Effectiveness: Rated in accordance with ASHRAE Std 84 and AHRI 1060.

C. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.

D. Smoke Developed Index: 50, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.

E. Energy Recovery Media Facing:
1. Conform to NFPA 90A.

F. Coat all corrugated surfaces with a thin non-migrating absorbent layer.

2.06 FILTERS

A. Efficiency: 13 MERV.

B. Fresh Air Stream: MERV 13 filters constructed to meet ASHRAE Std 52.2.

C. Exhaust Air Stream: MERV 8 filters constructed to meet ASHRAE Std 52.2.

D. Filter Racks: Bolt-on rack constructed of 0.08 inch, minimum, thick aluminum with hinged side access door and snap fasteners.

E. Filter Removal Hooks: Provide means to remove filters that are not immediately accessible from exterior of unit

F. Mount 1/2 inches thick permanent aluminum washable type filter in the outside air hood and in the return plenum air.

2.07 DAMPERS

A. Motorized Dampers: Provide motorized dampers at outside air inlet, exhaust air outlet, and supply air outlet.
   1. Type: Motorized two position low-leak.
   2. Blades: Insulated, single blade damper.

2.08 VIBRATION ISOLATION

A. Vibration Isolation: Provide enclosed spring isolators having minimum 2" static deflection.

B. Construct with appropriately-sized, seismic-rated, corrosion-resistant captive-spring isolators.

2.09 POWER AND CONTROLS

A. Motor Control Panels: UL listed.

B. Include necessary motor starters, VFDs, fuses, transformers and overload protection according to NFPA 70.

C. Provide single-point field connection to power supply.

D. Provide non fused main disconnect integral to control panel.

E. Install wiring in accordance with NFPA 70.

F. Wiring: Enclosed in flexible, liquid tight steel conduit.

2.10 ACCESSORIES

A. Electric Preheat Coil (Duct Mounted):
   1. Resistance coil type with elements enclosed in a steel sheath with fins and painted with a baked-on aluminum paint for long life in a 100% fresh air stream.
   2. Coil: UL listed and constructed in accordance with NFPA 70 requirements.
   3. Controls: Factory-provided SCR controls to maintain defined temperature (see schedule for details).

2.11 SERVICE ACCESSORIES

A. Internal Service Lights: Provide vapor tight light with protective cage and minimum 40 watt bulb.

B. Electrical Receptacle:
   1. Provide duplex, ground fault interrupter type receptacle.
   2. Provide re-settable circuit breaker in control panel.

C. Switch: 2 type.
   1. Two Position Type: Service and Operate.

D. Electrical Components: Factory wired for single point power connection.
   1. 60 Hz power connection.
   2. Isolate electrical box from the airflow.
   3. Protect all integral wires and connections.
   4. Electrical Components: UL Listed.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 INSTALLATION

A. Provide openings for suitable ductwork connection.

3.03 SYSTEM STARTUP

A. Provide services of manufacturer's authorized representative to provide start up of unit.

3.04 CLEANING

A. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

END OF SECTION

SECTION 23 83 00
RADIANT HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electric infrared radiant heaters.

1.02 RELATED REQUIREMENTS

A. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

END OF SECTION

SECTION 26 05 01
MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 RELATED REQUIREMENTS

A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation. and existing record documents.

D. Report discrepancies to Owner before disturbing existing installation.

E. Report discrepancies to Architect before disturbing existing installation.

F. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Armored cable.
C. Metal-clad cable.
D. Wiring connectors.
E. Electrical tape.
F. Heat shrink tubing.
G. Oxide inhibiting compound.
H. Wire pulling lubricant.
I. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 01 - Minor Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
E. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.
F. Section 31 23 16 - Excavation.
G. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
H. Section 31 23 23 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.
G. NECA 1 - Standard for Good Workmanship in Electrical Construction.
H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC).

I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

K. NFPA 70 - National Electrical Code.

L. UL 4 - Armored Cable.

M. UL 44 - Thermoset-Insulated Wires and Cables.

N. UL 83 - Thermoplastic-Insulated Wires and Cables.

O. UL 486A-486B - Wire Connectors.

P. UL 486C - Splicing Wire Connectors.

Q. UL 486D - Sealed Wire Connector Systems.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

S. UL 1569 - Metal-Clad Cables.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.

D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.

H. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

I. Conductor Material:
   1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
   2. Tinned Copper Conductors: Comply with ASTM B33.

J. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

K. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
   a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c. Equipment Ground, All Systems: Green.
   d. Isolated Ground, All Systems: Green with yellow stripe.
   e. Travelers for 3-Way and 4-Way Switching: Pink.
   f. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Southwire Company: www.southwire.com/#sle.
      c. Houston Wire & Cable co.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 ARMORED CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bonding wire.
   1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.

G. Armor: Steel, interlocked tape.

2.05 METAL-CLAD CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide dedicated neutral conductor for each phase conductor where indicated or required.

G. Grounding: Full-size integral equipment grounding conductor.
   1. Provide additional isolated/insulated grounding conductor where indicated or required.

H. Armor: Steel, interlocked tape.

I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.06 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Sizes 10 and under: Use twist-on insulated spring connectors.
   2. Copper Conductors Sizes 8 and larger: Use mechanical connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
1. Manufacturers:
   a. 3M: www.3m.com/#sle.
   b. Ideal Industries, Inc: www.idealindustries.com/#sle.
   c. NSI Industries LLC: www.nsiindustries.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

H. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
   a. Burndy: www.burndy.com.
   b. Ilsco: www.ilsco.com/#sle.
   c. Thomas & Betts Corporation: www.tnb.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
   a. Burndy: www.burndy.com.
   b. Ilsco: www.ilsco.com/#sle.
   c. Thomas & Betts Corporation: www.tnb.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
   a. 3M: www.3m.com/#sle.
   b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
   c. Substitutions: See Section 01 60 00 - Product Requirements.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
   a. Product: 3 M.
   b. Substitutions: See Section 01 60 00 - Product Requirements.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
   a. Product: 3 M.
   b. Substitutions: See Section 01 60 00 - Product Requirements.

4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Burndy: www.burndy.com.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
   1. Manufacturers:
      a. Burndy: www.burndy.com.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. Ilsco: www.ilsco.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. American Polywater Corporation: www.polywater.com/#sle.
      c. Ideal Industries, Inc: www.idealindustries.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as shown on the drawings.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated and routing is not shown, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location shown.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install armored cable (Type AC) in accordance with NECA 120.

E. Install metal-clad cable (Type MC) in accordance with NECA 120.

F. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

I. Terminate cables using suitable fittings.
   1. Armored Cable (Type AC):
      a. Use listed fittings and anti-short, insulating bushings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
   2. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

J. Install conductors with a minimum of 12 inches of slack at each outlet.

K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
      b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

R. Identify conductors and cables in accordance with Section 26 05 53.

S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

F. Ground access wells.

G. Grounding and bonding components.

H. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Existing metal underground water pipe.
   2. Metal frame of the building.
   3. Existing metal underground gas piping system.
   4. Metal underground gas piping system.

1.02 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

E. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.

F. NFPA 70 - National Electrical Code.

G. UL 467 - Grounding and Bonding Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:

D. Product Data: Provide for grounding electrodes and connections.

E. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual locations of grounding electrode system components and connections.

H. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal Building or Structure Frame:
      a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible location.
   4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

F. Service-Supplied System Grounding:
   1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
   2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Bonding and Equipment Grounding:
   1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
   2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
   3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
   4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
   5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
   6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
   7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:

a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
b. Metal gas piping.

8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame where not used as a grounding electrode.

H. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

I. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 05 19:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
a. Exceptions:
1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use exothermic welded connections for accessible connections.
a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Burndy: www.burndy.com.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy: www.burndy.com.
b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.

c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com/#sle.
e. Substitutions: See Section 01 60 00 - Product Requirements.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
4. Manufacturers:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
d. Harger Lightning & Grounding: www.harger.com/#sle.
e. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.

B. Framatome Connectors International: www.fciconnect.com.

C. Lightning Master Corporation: www.lightningmaster.com.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.
1. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wire: Stranded copper.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 05 53.

F. Provide bonding to meet requirements described in Quality Assurance.

G. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Each of branch circuits and feeder circuits shall have dedicated equipment grounding conductor, sharing this conductor with other grounding conductors is not permitted.

3.03 FIELD QUALITY CONTROL

A. Perform inspection in accordance with Section 01 40 00.

B. Inspect and test in accordance with NETA STD ATS except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 26 05 34 - Conduit: Additional support and attachment requirements for conduits.

D. Section 26 05 37 - Boxes: Additional support and attachment requirements for boxes.

E. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

F. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. MFMA-4 - Metal Framing Standards Publication.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NFPA 70 - National Electrical Code.

G. UL 5B - Strut-Type Channel Raceways and Fittings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Installer's Qualifications: Include evidence of compliance with specified requirements.

E. Product Data: Provide manufacturer's catalog data for fastening systems.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

E. Installer Qualifications for Field-Welding: As specified in Section 05 50 00.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.

C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.
   2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
   5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
   6. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Thomas & Betts Corporation: www.tnb.com/#sle.
      c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
      e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch diameter.
      c. Single Conduit larger than 1 inch (27mm) trade size: 3/8 inch diameter.
      d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
      e. Outlet Boxes: 1/4 inch diameter.

f. Luminaires: 1/4 inch diameter.

G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Powder-actuated fasteners are not permitted.
9. Hammer-driven anchors and fasteners are not permitted.
10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
a. Comply with MFMA-4.
b. Channel Material: Use galvanized steel.
c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

2.02 MANUFACTURERS

A. Thomas & Betts Corporation: www.tnb.com.

B. Threaded Rod Company: www.threadedrod.com.

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:
1. Do not use powder-actuated anchors.
2. Obtain permission from Architect before using powder-actuated anchors.
3. Concrete Structural Elements: Use precast inserts.
4. Steel Structural Elements: Use beam clamps.
5. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use hollow wall fasteners.
7. Solid Masonry Walls: Use expansion anchors.
8. Sheet Metal: Use sheet metal screws.
9. Wood Elements: Use wood screws.

D. Formed Steel Channel:
1. Product: manufactured by [B-Line.
2. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: Also comply with Section 26 05 34.

I. Box Support and Attachment: Also comply with Section 26 05 37.

J. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.

K. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.

L. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

M. Secure fasteners according to manufacturer's recommended torque settings.

N. Remove temporary supports.

O. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 05 34
CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Flexible metal conduit (FMC).
C. Liquidtight flexible metal conduit (LFMC).
D. Electrical metallic tubing (EMT).
E. Rigid polyvinyl chloride (PVC) conduit.
F. Conduit fittings.
G. Accessories.
H. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.
B. Section 07 84 00 - Firestopping.
C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
E. Section 26 05 29 - Hangers and Supports for Electrical Systems.
F. Section 26 0553 - Identification for Electrical Systems.
G. Section 26 05 37 - Boxes.
H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
I. Section 31 23 16 - Excavation.
J. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).
C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A).
D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
H. NFPA 70 - National Electrical Code.
I. UL 1 - Flexible Metal Conduit.
J. UL 6 - Electrical Rigid Metal Conduit-Steel.
K. UL 360 - Liquid-Tight Flexible Steel Conduit.

L. UL 514B - Conduit, Tubing, and Cable Fittings.

M. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

N. UL 797 - Electrical Metallic Tubing-Steel.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
   2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

E. Product Data: Provide for metallic conduit and flexible metal conduit.

F. Samples of Materials Actually Delivered to Site:
   1. Two pieces each of conduit, 2 feet long.

G. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use rigid PVC conduit.
   3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
   5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.

D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit.

E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).

F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit.

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

J. Exposed, Exterior: Use galvanized steel rigid metal conduit.

K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.

L. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

M. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.
      c. HVAC equipment.

N. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labelenoned by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.

C. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 3/4 inch (21 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Control Circuits: 1/2 inch (16 mm) trade size.
   4. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.
   5. Underground, Interior: 3/4 inch (21 mm) trade size.
   6. Underground, Exterior: 1 inch (27 mm) trade size.

D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube Company: www.wheatland.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
   4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 METAL CONDUIT

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedtube.com.
   2. Beck Manufacturing, Inc: www.beckmfg.com.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.05 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
   2. Electri-Flex Company: www.electriflex.com/#sle.

3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings with insulated bushing complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction.

E. Fittings: NEMA FB 1.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. International Metal Hose: www.metalhose.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings with insulated bushing complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

2.07 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube Company: www.wheatland.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.

b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Description: Fittings with insulated bushings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
   a. Do not use indenter type connectors and couplings.
5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
   3. JM Eagle: www.jmeagle.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

E. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

E. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated and routing is not shown, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Arrange conduit to maintain adequate headroom, clearances, and access.
   6. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   7. Arrange conduit to provide no more than 150 feet between pull points.
   8. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   9. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   10. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.
   11. Group parallel conduits in the same area together on a common rack.

F. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
   8. Use of spring steel conduit clips for support of conduits is not permitted.
   9. Use of wire for support of conduits is not permitted.
      a. For securing conduits to studs in hollow stud walls.
      b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).

G. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

I. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 23 16.13.
2. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.
3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length.

J. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

K. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

M. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

O. Provide grounding and bonding in accordance with Section 26 05 26.

P. Identify conduits in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

3.06 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation specified in Section roofing section.

END OF SECTION

SECTION 26 05 37
BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Wall and ceiling outlet boxes.

D. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 27 26 - Wiring Devices:
   1. Wall plates.

E. Section 26 2716 - Electrical Cabinets and Enclosures.

F. Section 26 2726 - Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NFPA 70 - National Electrical Code.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

J. UL 508A - UL Standard for Safety Industrial Control Panels.

K. UL 514A - Metallic Outlet Boxes.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.

5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use suitable concrete type boxes where flush-mounted in concrete.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.
   5. Use raised covers suitable for the type of wall construction and device configuration where required.
   6. Use shallow boxes where required by the type of wall construction.
   7. Do not use "through-wall" boxes designed for access from both sides of wall.
   8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
   12. Wall Plates: Comply with Section 26 27 26.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   3. Junction and Pull Boxes Larger Than 100 cubic inches:
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

2.02 MANUFACTURERS

A. Appleton Electric: www.appletonelec.com.

B. Steel City

C. Substitutions: Reco, Inc. See Section 01 60 00 - Product Requirements.

2.03 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.

B. Nonmetallic Outlet Boxes: NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 2726.

2.04 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable, _4 inches deep.

B. Material: Cast metal.

C. Shape: Rectangular.

D. Service Fittings: As specified in Section 26 2726.

2.05 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 26 2716.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron; Cast Aluminum.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
   1. Material: Galvanized cast iron; Cast Aluminum.
   2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
   3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.01 EXAMINATION

3.02

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

E. Install boxes plumb and level.

F. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
   2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
   3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

G. Install boxes as required to preserve insulation integrity.

H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

I. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

J. Close unused box openings.

K. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

L. Provide grounding and bonding in accordance with Section 26 05 26.

M. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

N. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

O. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.

P. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

Q. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
   1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

R. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

S. Maintain headroom and present neat mechanical appearance.

T. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

U. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

V. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

W. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

X. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

Y. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

Z. Use flush mounting outlet box in finished areas.

AA. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

AB. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

AC. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

AD. Use stamped steel bridges to fasten flush mounting outlet box between studs.

AE. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

AF. Use adjustable steel channel fasteners for hung ceiling outlet box.

AG. Do not fasten boxes to ceiling support wires.

AH. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

AI. Use gang box where more than one device is mounted together. Do not use sectional box.

AJ. Use gang box with plaster ring for single device outlets.

AK. Use cast outlet box in exterior locations exposed to the weather and wet locations.

AL. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

AM. Set floor boxes level.

AN. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.04 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.05 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.06 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Warning signs and labels.

F. Field-painted identification of conduit.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating.

B. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Arc flash hazard warning labels.

C. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. UL 969 - Marking and Labeling Systems.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.06 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements for additional requirements.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    a. Panelboards:
        1) Identify power source and circuit number. Include location when not within sight of equipment.
        2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Transformers:
1) Identify kVA rating.
2) Identify voltage and phase for primary and secondary.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.

c. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

2. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
3. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
4. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
6. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Seton Identification Products: www.seton.com/aec.

C. HellermannTyton: www.hellermanntyton.com.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. Equipment Designation: 1/2 inch.
5. Color:
   a. Normal Power System: White text on black background.

D. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
   a. Include voltage and phase for other than 120 V, single phase circuits.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

E. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

F. Locations:
1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.
3. Disconnect switches, and starters.

G. Letter Size:
1. Use 1/8 inch letters for identifying individual equipment and loads.
2. Use 1/4 inch letters for identifying grouped equipment and loads.

2.04 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Panduit Corp.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

H. Description: split sleeve type wire markers.

I. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

J. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on shop drawings.

2.05 VOLTAGE MARKERS

A. Manufacturers: Panduit Corp
   1. Substitutions: See Section 01 60 00 - Product Requirements.

B. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

C. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
   2. Markers for System Identification:
      a. Emergency Power System: Text "EMERGENCY".
      b. Other Systems: Type of service.

D. Color: Black text on orange background unless otherwise indicated.

E. Location: Furnish markers for each conduit longer than 6 feet.

F. Spacing: 20 feet on center.

G. Color:
   1. 480 Volt System: Brown.
   2. 208 Volt System: Yellow.
   3. Fire Alarm System: Red.

H. Legend:
   1. 480 Volt System: brown.
   2. 208 Volt System: yellow.
   3. Fire Alarm System: red.

2.06 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
   2. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conductors and Cables: Legible from the point of access.
   8. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.
B. Short circuit study.
C. Coordination study and analysis.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
C. Scheduling:
   1. Arrange access to existing facility for data collection with Owner.
   2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Study reports, stamped or sealed and signed by study preparer.
C. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
   1. Identify modifications made in accordance with studies that:
      a. Can be made at no additional cost to Owner.
      b. As submitted will involve a change to the contract sum.
D. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
E. Study Report: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
   1. Include stamp or seal and signature of preparing engineer.
F. Field quality control reports.

1.04 PROTECTIVE DEVICE STUDY

A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
   1. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
   2. Report: State the methodology and rationale employed in making each type of calculation; identify computer software package(s) used.

B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
   1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.
   2. Breaker and fuse ratings.
   3. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
   4. Identification of each bus, with voltage.
   5. Conduit materials, feeder sizes, actual lengths, and X/R ratios.

C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
   1. Show fault currents available at key points in the system down to a fault current of 7,000 A at 480 V and 208 V.
   2. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
   3. Report: Include all pertinent data used in calculations and for each device include:
      a. Device identification.
      b. Protective device.
      c. Device rating.
      d. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.

D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
   1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
   2. Plot the specific time-current characteristics of each protective device on log-log paper.
   3. Organize plots so that all upstream devices are clearly depicted on one sheet.
   4. Also show the following on curve plot sheets:
      a. Device identification.
      b. Voltage and current transformer ratios for curves.
      c. 3-phase and 1-phase ANSI damage curves for each transformer.
      d. No-damage, melting, and clearing curves for fuses.
      e. Cable damage curves.
      f. Transformer inrush points.
      g. Maximum short circuit cutoff point.
      h. Simple one-line diagram for the portion of the system that each curve plot illustrates.
      i. Software report for each curve plot, labeled for identification.

E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
   1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
   2. Identify any equipment that is underrated as specified.

3. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.
4. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.

F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
1. Device identification.
2. Relay CT ratios, tap, time dial, and instantaneous pickup.
3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
4. Fuse rating and type.
5. Ground fault pickup and time delay.
6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
7. Highlight all devices that as furnished by Contractor will not achieve required protection.

1.05 QUALITY ASSURANCE

A. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
a. SKM Systems Analysis, Inc: www.skm.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.

C. Owner's Responsibility: Provide data on relevant Owner power distribution equipment.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
1. Materials: Comply with Section 26 05 53.
2. Minimum Size: 4 by 6 inches.
3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
a. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
b. Include the following information:
1) Arc flash boundary.
2) Available incident energy and corresponding working distance.
3) Nominal system voltage.

2.02 PROTECTIVE DEVICES

PART 3 EXECUTION

3.01 INSTALLATION

A. Install arc flash warning labels in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Adjust equipment and protective devices for compliance with studies and recommended settings.

D. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

E. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose transformers.

B. K-factor transformers rated for nonlinear loads.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 34 - Conduit: Flexible conduit connections.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 05 34 - Conduit: Flexible conduit connections.

F. Section 26 24 16 - Panelboards.

1.03 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers.

C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers.

F. NEMA ST 1 - Specialty Transformers (Except General Purpose Type); National Electrical Manufacturers Association.

G. NEMA ST 20 - Dry-Type Transformers for General Applications.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

J. NFPA 70 - National Electrical Code.

K. UL 506 - Standard for Specialty Transformers.

L. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Coordination: Coordinate the work with placement of support framing and anchors required for mounting of transformers.

C. NEMA TR-1/ANSI 57.12.51 and 57.12.50

D. Federal Register - US department of Energy, Office of Energy Efficiency and Renewable Energy, 10 CFR Part 30, July 29, 2004. Energy Conservation Program for Commercial and Industrial Equipment, Energy Conservaiton Standards for Distribution Transformers, Proposed Rule.

E. ANSI/ASHRAE/IESNA 90.1 - Energy Efficient Design on New Buildings Except Low- Rise Residential Buildings.
   1. Transformer selection based on optimizing the combination of no-load, part-load, and full-load losses without compromising operational and reliability requirements for the building.

F. ANSI/NEMA TP-1 - Guide for Determining Energy Efficiency for Distribution Transformers.
   1. For Reference only. US DOE deos not consider NEMA TP-1 efficiency levels to reflect low life cycle cost.

G. ANSI/NEMA TP-2 - Standard Test Method for Measuring Energy Consumption of Distribution Transformers.

H. IEEE C57.110-1998 - IEEE Recommended Practice for establishing transformer capability when feeding nonsinusoidal load currents.
   1. Transformers losses increase in proportion to the mix of electronic equipment in the overall load fed from transformer.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

C. Provide linear load efficiency data at 25 %, 35%, 50 %, 75 % , and 100 % full load.
   1. Vibration Isolators: Include attachment method and rated load and deflection.
   2. K-factor Rated Transformers: Include K-factor ratings.

D. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

E. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, core and coil material and rated temperature rise.

F. Test Reports: Indicate loss data, efficiency at 0, 25, 50, 75 and 100 percent rated load, and sound level.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Maintenance Data: Include recommended maintenance procedures and intervals.

I. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

E. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
   1. Greater than 10 kVA: 104 degrees F maximum.
   2. Less than 10 kVA: 77 degrees F maximum.

B. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products; Premium 30 energy efficient: www.schneider-electric.us/#sle.

B. Eaton Electrical/Cutler-Hammer: www.eatonelectrical.com.

C. GE Industrial: www.geindustrial.com.

D. Powersmiths International Corp.

E. Substitutions: See Section 01 60 00 - Product Requirements.

F. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ALL TRANSFORMERS

A. Description: High performance,energy efficient, copper wound transformer with 30 % less loses than NEMA TP_1 . Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:

1. Altitude: Less than 3,300 feet.
2. Ambient Temperature:
   a. Greater than 10 kVA: Not exceeding 104 degrees F.
   b. Less than 10 kVA: Not exceeding 77 degrees F.
3. Ambient Temperature: Not exceeding 86 degrees F average or 104 degrees F maximum measured during any 24 hour period.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV for transformer up to 300 kva , 30 kv for transformer 300 kva and up.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase 4 wire.

D. Insulation System and Allowable Average Winding Temperature Rise:
   1. 15 kVA and Larger: Class 220 degrees C insulation system with 115 degrees C average winding temperature rise.

E. Coil Conductors: Continuous copper windings with terminations brazed or welded.

F. Winding Taps:
   1. Less than 3 kVA: None.
   2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
   3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
   4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: DOE 2016 energy efficiency levels.

H. Sound Levels: Low sound levels at least 5 db less than NEMA ST 20 standard sound levels.

I. Mounting Provisions:
   1. Less than 15 kVA: Suitable for wall mounting.
   2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
   3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor clean, dry locations: Type 2.

2. Construction: Heavy gage steel.
   a. Less than 15 kVA: Totally enclosed, non-ventilated.
   b. 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

K. Accessories:
   1. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.04 K-FACTOR TRANSFORMERS RATED FOR NONLINEAR LOADS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 1561, and designed to supply nonlinear loads to the degree designated by the UL defined K-factor; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. K-factor Rating: K-4, or higher.

E. Insulation System and Allowable Average Winding Temperature Rise: Class 220 degrees C insulation system with 115 degrees C average winding temperature rise.

F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.

G. Winding Taps: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.

H. Neutral Bus: Sized to accommodate twice the rated secondary current.

I. Energy Efficiency: Comply with DOE 2016 requirements.

J. Sound Levels: Low sound levels at least 5 db less than NEMA ST 20 standard sound levels.

2.05 SOURCE QUALITY CONTROL

A. Factory test transformers according to NEMA ST 20.

B. Production test each unit according to NEMA ST 20.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install transformers in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 05 34, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Set transformers plumb and level.

G. Use flexible conduit, under the provisions of Section 26 0534, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

H. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

I. Mount floor-mounted transformers on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.

J. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.

K. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

L. Mount trapeze-mounted transformers as indicated.

M. Provide seismic restraints.

N. Provide grounding and bonding in accordance with Section 26 05 26.

O. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

P. Where not factory-installed, install lugs sized as required for termination of conductors as shown on the drawings.

Q. Identify transformers in accordance with Section 26 05 53.

R. Install transformer identification nameplate in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.

C. Inspect and test in accordance with NETA STD ATS, except Section 4.

D. Perform inspections and tests listed in NETA STD ATS, Section 7.2.1.1. In addition to the basic requirements of Section 7.2, include the following:
   1. Perform turns ratio tests at all tap positions.
   2. Verification that as-left tap connections are as specified.
   3. Perform excitation-current tests on each phase.
   4. Measure the resistance of each winding at each tap connection.
   5. Overpotential test on all high- and low-voltage windings-to-ground.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 24 13
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Switchboards.

B. Overcurrent protective devices for switchboards.

C. Switchboard accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for supporting foundations and pads.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

F. Section 26 27 01 - Electrical Service Entrance.

G. Section 26 28 13 - Fuses.

H. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. ANSI C12.1 - American National Standard Code for Electricity Metering.

C. ANSI C39.1 - American National Standard Requirements for Electrical Analog Indicating Instruments; 1981 (R1992).

D. IEC 60051-1 - Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 1: Definitions and General Requirements Common To All Parts;.

E. IEC 60051-2 - Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 2: Special Requirements for Ammeters and Voltmeters.

F. IEEE C12.1 - American National Standard Code for Electricity Metering; Institute of Electrical and Electronic Engineers; 1988.

G. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction.

I. NECA 400 - Standard for Installing and Maintaining Switchboards.

J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

K. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

L. NEMA PB 2 - Deadfront Distribution Switchboards.

M. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

N. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

O. NFPA 70 - National Electrical Code.

P. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

Q. UL 891 - Switchboards.

R. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
   1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchboard prior to fabrication.
   4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings.
   5. Include documentation demonstrating selective coordination.

D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

E. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

F. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

G. Test Reports: Indicate results of factory production tests.

H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Project Record Documents: Record actual locations of switchboards.

J. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

E. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

F. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

G. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards - Basis of Design: Schneider Electric co. QED power style switchboard.

B. Switchboards - Other Acceptable Manufacturers:
   1. Eaton Corporation: www.eaton.com.
   2. General Electric Company: www.geindustrial.com/#sle.

C. Substitutions: See Section 01 60 00 - Product Requirements.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.

F. Schneider Electric; Square D Products: www.schneider-electric.us.

G. Substitutions: See Section 01 60 00 - Product Requirements.

H. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

I. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Front-Connected Switchboards:
   1. Main Device(s): Individually-mounted.
   2. Feeder Devices: Panel/group-mounted.
   3. Arrangement: Front accessible only (not rear accessible), rear aligned.
   4. Gutter Access: Bolted covers.
   5. Basis of Design: Schneider Electric QED power style switchboard.

E. Service Conditions:
   1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet.
      b. Ambient Temperature:
         1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
   2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
      a. Altitude: 1000 feet.
      b. Ambient Temperature: Between 23 degrees F and 104 degrees F.

F. Short Circuit Current Rating:
   1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Minimum Rating: 65,000 rms symmetrical amperes.
   3. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.

4. Label equipment utilizing series ratings as required by NFPA 70.

G. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

H. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

I. Bussing: Sized in accordance with UL 891 temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
   2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Phase and Neutral Bus Material: Copper.
   5. Ground Bus Material: Copper.

J. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Copper, suitable for terminating copper conductors only.
      b. Lug Type:
         1) Provide mechanical lugs unless otherwise indicated.
         2) Provide compression lugs where indicated.

K. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
   2. Finish: Manufacturer's standard unless otherwise indicated.

L. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
   2. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections.

M. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list switchboards as a complete assembly including surge protective device.

N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
   2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
      a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
      b. Provide test panel and field-adjustable ground fault pick-up and delay settings.

O. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

P. Owner Metering:
   1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
   2. Basis of Design: ION 7350.
   3. Measured Parameters:
      a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      b. Current (Amps): For each phase and neutral.
      c. Frequency (Hz).
      d. Real power (kW): For each phase, 3-phase total.
      e. Reactive power (kVAR): For each phase, 3-phase total.
      f. Apparent power (kVA): For each phase, 3-phase total.
      g. Power factor.
      h. Current demand.
      i. Power demand: Real, reactive, and apparent.
   4. Meter Accuracy: Plus/minus 1.0 percent.
   5. Features:
      a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
      b. Remote monitoring capability via PC.

Q. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

R. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

S. Ratings:
   1. Voltage: 120/208; 277/480 volts.
   2. Configuration: Three phase, four wire, grounded.
   3. Main Bus: 2000 amps.277/480 v, 2000 amps, 208/120v .
   4. Integrated Equipment Rating: 100000 rms amperes symmetrical.

T. Main Section Devices: Individually mounted and compartmented.

U. Distribution Section Devices: _Group mounted- double row sections.

V. Bus Material: Copper with tin plating, standard size.

W. Bus Connections: Bolted, accessible from front for maintenance.

X. Fully insulate load side bus bars

Y. Ground Bus: Extend length of switchboard.

Z. Insulated Ground Bus: Extend length of switchboard.

AA. Molded Case Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole.
   1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
   2. Include shunt trip where indicated.
   3. Circuit Breakers 1- 400amp and up shall be provided with field repalceable trip unit.

4. All Feeder breakers in 208/120v swithboard shall be series rated for min. of 65 kAIC with 1-pole circuit breakers in all panelboards.All feeder breakers in 480y/277v ,3ph4w switchboard shall be series rated for min. of 65 KAIC.

AB. Solid-State Molded Case Circuit Breakers: With electronic sensing, timing and tripping circuits for adjustable current settings; UL listed.
1. Ground fault trip, ground fault sensing integral with circuit breaker.
2. Instantaneous trip.
3. Adjustable short time/ long time trip.
4. Stationary mounting.
5. Include shunt trip where indicated.

AC. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.

AD. Ground Fault Sensor: Zero sequence type.

AE. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.Max time delay shall be one second for ground fault currents equal to or greater ethan 3000 amps.

AF. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

AG. Enclosure: Type _NEMA 1-Indoors.
1. Align sections at front and rear.
2. Switchboard Height: 91.5 inches, excluding floor sills, lifting members and pull boxes.
3. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
4. Structure: Free standing, self supporting, totally front accessible.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
1. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
2. Molded Case Circuit Breakers:
   a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      1) Provide thermal magnetic circuit breakers unless otherwise indicated.
      2) Provide electronic trip circuit breakers where indicated.
   b. Minimum Interrupting Capacity:
      1) 14000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) 21000 rms symmetrical amperes at 480 VAC.

c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.

d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   1) Provide the following field-adjustable trip response settings:
      (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      (b) Long time delay.
      (c) Short time pickup and delay.
      (d) Instantaneous pickup.
      (e) Ground fault pickup and delay where ground fault protection is indicated.

e. Provide the following features and accessories where indicated or where required to complete installation:
   1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2.04 SURGE PROTECTIVE DEVICES

A. See Section for factory-installed, internally mounted surge protective devices. List and label switchboards containing surge protective devices as a complete assembly including surge protective device.

2.05 POWER METERS

A. Manufacturers:
   1. SQ D ION 7350 or approved equal.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Watt-Hour Meters and Wattmeters: ANSI C12.1, three phase induction type with two stators, each with current and potential coil, rated 5 amperes and 120 volts at 60 Hertz.
   1. Meter suitable for connection to 3- and 4-wire circuits.
   2. Potential indicating lamps.
   3. Adjustments for light and full load, phase balance, and power factor.
   4. Digital register.
   5. Integral demand indicator.
   6. Ratchets to prevent reverse rotation.
   7. Removable meter with draw-out test plug.
   8. Semi-flush mounted case with matching cover.
   9. BACnet gateway to provide connection to building automation system.

C. Provide meters with appropriate multiplier tags.

2.06 METERING TRANSFORMERS

A. Manufacturers:
   1. Square D or equal.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Current Transformers: IEEE C57.13, 5 ampere secondary, wound; bushing; bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

C. Potential Transformers: IEEE C57.13, 120 volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

2.07 SOURCE QUALITY CONTROL

A. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

B. Shop inspect and test switchboard according to NEMA PB 2.

C. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least 7 days before inspection is allowed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide concrete housekeeping pad under the provisions of Section .

B. Verify that field measurements are as instructed by manufacturer.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.

E. Provide required support and attachment components in accordance with Section 26 05 29.

F. Install switchboards plumb and level.

G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.

H. Provide grounding and bonding in accordance with Section 26 05 26.

I. Install all field-installed devices, components, and accessories.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 05 73.

L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
M. Provide filler plates to cover unused spaces in switchboards.
N. Identify switchboards in accordance with Section 26 05 53.
O. Install switchboard in locations shown on drawings, according to NEMA PB 2.1.
P. Install in a neat and workmanlike manner, as specified in NECA 400.
Q. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
R. Identify switchboards in accordance with Section 26 05 53.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
C. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
D. Perform field inspection and testing in accordance with Section .
E. Inspect and test in accordance with NETA STD ATS, except Section 4.
F. Perform inspections and tests listed in NETA STD ATS, Section 7.1.
G. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 225 amperes. Tests listed as optional are not required.
H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
    1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
I. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
J. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10.
K. Test shunt trips to verify proper operation.
L. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.05 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
B. Adjust alignment of switchboard covers and doors.
C. Adjust all operating mechanisms for free mechanical movement.
D. Tighten bolted bus connections in accordance with manufacturer's instructions.
E. Adjust circuit breaker trip and time delay settings to values indicated.
F. Adjust circuit breaker trip and time delay settings to values as instructed by Architect.

3.06 CLEANING

A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
B. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

C. Touch up scratched or marred surfaces to match original finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

3.08 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

D. Section 26 05 29 - Hangers and Supports for Electrical Systems.

E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 26 22 00 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

H. Section 26 28 13 - Fuses: Fuses for fusible switches and spare fuse cabinets.

I. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 407 - Standard for Installing and Maintaining Panelboards.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

G. NEMA PB 1 - Panelboards.

H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

J. NFPA 70 - National Electrical Code.

K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

M. UL 67 - Panelboards.

N. UL 98 - Enclosed and Dead-Front Switches.

O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

P. UL 869A - Reference Standard for Service Equipment.

Q. UL 943 - Ground-Fault Circuit-Interrupters.

R. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include wiring diagrams showing all factory and field connections.
   2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

1.09 MAINTENANCE MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.

B. General Electric Company: www.geindustrial.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Substitutions: See Section 01 60 00 - Product Requirements.

E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ALL PANELBOARDS

A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   3. Label equipment utilizing series ratings as required by NFPA 70.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.
   5. Metal frame for type written directory

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
   1. Ampere Rating: Not less than ampere rating of panelboard bus.
   2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
   3. Coil Voltage: As required for connection to control system indicated.

L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Products:
   1. SQ D .
   2. General Electric.
   3. Eaton Cutler Hammer.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

D. Bussing:
   1. Phase and Neutral Bus Material: Copper.
   2. Ground Bus Material: Copper.

E. Circuit Breakers:
   1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
   2. Provide thermal magnetic circuit breakers unless otherwise indicated.
   3. Provide electronic trip circuit breakers where indicated.

F. Enclosures:
   1. Provide surface-mounted enclosures unless otherwise indicated.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable continous hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide metal circuit directory holder mounted on inside of door.

G. Manufacturers:
   1. SQ.D or Equal.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

H. Description: NEMA PB 1, circuit breaker type.

I. Service Conditions:
   1. Altitude: 1000 feet.
   2. Temperature: 55 degrees F.

J. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

K. Minimum integrated short circuit rating: As indicated.
   1. 240 Volt Panelboards: 14,000 amperes rms symmetrical (minimum).
   2. 480 Volt Panelboards: 22,000 amperes rms symmetrical (minimum).

L. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.

M. Molded Case Circuit Breakers with Current Limiters: With replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole; UL listed.

N. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

O. Enclosure: NEMA PB 1, Type 1, 5 34" deep, 20" wide, cabinet box. With continued hinge and lock.

P. Cabinet Front: Surface type, fastened with , hinged door with flush lock, finished in manufacturer's standard gray enamel.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Products:
   1. SQD.

2. General Electric.
3. Eaton Cutler Hammer.
4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
2. Main and Neutral Lug Type: Mechanical.

D. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Copper.
3. Ground Bus Material: Copper.

E. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

F. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable continous hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide metal circuit directory holder mounted on inside of door.

G. Manufacturers:
1. SQ.D or Equal.
2. Substitutions: See Section 01 60 00 - Product Requirements.

H. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

I. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

J. Minimum Integrated Short Circuit Rating: As indicated.
1. 240 Volt Panelboards: 14,000 amperes rms symmetrical (minimum).
2. 480 Volt Panelboards: 22,000 amperes rms symmetrical (minimum).

K. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
1. Type SWD for lighting circuits.
2. Type HACR for air conditioning equipment circuits.
3. Class A ground fault interrupter circuit breakers where scheduled.
4. Do not use tandem circuit breakers, or miniature circuit breakers.

L. Enclosure: NEMA PB 1, Type 1.

M. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.

N. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   1) 14000 rms symmetrical amperes at 240 VAC or 208 VAC.
   2) 22000 rms symmetrical amperes at 480 VAC.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Copper, suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following field-adjustable trip response settings:
      1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      2) Long time delay.
      3) Short time pickup and delay.
      4) Instantaneous pickup.
      5) Ground fault pickup and delay where ground fault protection is indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
10. Do not use tandem circuit breakers.
11. Do not use handle ties in lieu of multi-pole circuit breakers.

2.06 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 05 29.

E. Install panelboards plumb.

F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Mount floor-mounted power distribution panelboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.

I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 26 05 26.
   1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
   2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

K. Install all field-installed branch devices, components, and accessories.

L. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 05 73.

M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

N. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.

O. Install panelboards plumb. Install recessed panelboards flush with wall finishes, where installed surface mounted secure or anchor panelboard to brick or cinder block wall.

P. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

Q. Provide filler plates to cover unused spaces in panelboards.

R. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Emergency and night lighting circuits.
   2. Fire detection and alarm circuits.
   3. Communications equipment circuits.
   4. Intrusion detection and access control system circuits.
   5. Video surveillance system circuits.

S. Identify panelboards in accordance with Section 26 05 53.

T. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.

U. Provide identification nameplate for each panelboard in accordance with Section 26 0553.

V. Provide arc flash warning labels in accordance with NFPA 70.

W. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
   1. Minimum spare conduits: 5 empty 1 inch.

X. Ground and bond panelboard enclosure according to Section 26 0526.

3.03 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA STD ATS, except Section 4.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Test GFCI circuit breakers to verify proper operation.

F. Test shunt trips to verify proper operation.

G. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

I. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 27 17
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 05 34 - Conduit.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).

C. Section 26 05 37 - Boxes.

D. Section 26 27 26 - Wiring Devices.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

C. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
   4. Product:
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Disconnect Switches: As specified in Section and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 27 26.

D. Flexible Conduit: As specified in Section 26 05 34.

E. Wire and Cable: As specified in Section 26 05 19.

F. Boxes: As specified in Section 26 05 37.

2.02 EQUIPMENT CONNECTIONS

A. As required by equipment manufacturer:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

1.02 RELATED REQUIREMENTS

A. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Additional criteria for the selection of protective devices specified in this section.

C. Section 26 24 13 - Switchboards: Fusible switches.

D. Section 26 24 16 - Panelboards: Fusible switches.

E. Section 26 28 18 - Enclosed Switches: Fusible switches.

F. Section 26 29 13 - Enclosed Controllers: Fusible switches.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. NFPA 70 - National Electrical Code.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses.

E. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
      a. Fusible Switches for Enclosed Motor Controllers: See Section 26 29 13.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Fuses: One set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

E. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 MAINTENANCE MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Furnish two fuse pullers.

C. Furnish three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Bussmann, a division of Cooper Industries: www.cooperindustries.com/#sle.

B. Mersen (formerly Ferraz Shawmut): ferrazshawmut.mersen.com.

C. Littelfuse, Inc: www.littelfuse.com/#sle.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 APPLICATIONS

A. Service Entrance:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

B. General Purpose Branch Circuits: Class RK1, time-delay.

C. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class CC Fuses: Comply with UL 248-4.

I. Power Load Feeder Switches: Class RK1 (time delay).

J. Motor Load Feeder Switches: Class RK1 (time delay).

K. Other Feeder Switches: Class RK1 (time delay).

L. General Purpose Branch Circuits: Class RK1 (time delay).

M. Motor Branch Circuits: Class L time delay.

N. Lighting Branch Circuits: Class G.

2.04 CLASS RK1 (TIME DELAY) FUSES

A. Manufacturers:
   1. Bussman Corp.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction: Current limiting, dual-element fuse, 10 seconds minimum at 500% rated amps, with copper fuse element.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 28 18
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

B. Fusible switches.

C. Nonfusible switches.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Additional criteria for the selection of equipment and associated protective devices specified in this section.

E. Section 26 28 13 - Fuses.

F. Section 26 29 13 - Enclosed Controllers: Manual motor controllers.

G. Section 26 36 00 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

F. NFPA 70 - National Electrical Code.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

I. UL 98 - Enclosed and Dead-Front Switches.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Project Record Documents: Record actual locations of enclosed switches.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Products; Model : www.eaton.com/#sle.

B. General Electric Company; Model : www.geindustrial.com/#sle.

C. Schneider Electric; Square D Products; Model : www.schneider-electric.us/#sle.

D. Substitutions: See Section 01 60 00 - Product Requirements.

E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.

L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

M. Heavy Duty Switches:
   1. Products:
      a. Schneider Electric.
      b. General Electric Co.
      c. Cutler Hammer.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Comply with NEMA KS 1.

3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Provide compression lugs where indicated.
   c. Lug Material: Copper, suitable for terminating copper conductors only.
4. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.03 COMPONENTS

A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.
   3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 05 29.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Provide identification nameplate for each enclosed switch in accordance with Section 26 0553.

J. Provide arc flash warning labels in accordance with NFPA 70.

K. Install fuses in fusible disconnect switches.

L. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 29 13
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
   1. Manual motor starters.

B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section 26 28 13 - Fuses: Fuses for fusible switches.

1.03 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

E. NEMA ICS 6 - Industrial Control and Systems: Enclosures.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

H. NFPA 70 - National Electrical Code.

I. UL 98 - Enclosed and Dead-Front Switches.

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

K. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules.

L. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
   3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.

4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
   1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
   2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 ENCLOSED MOTOR CONTROLLERS

A. Provide enclosed motor controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed motor controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
   1. Provide motor controllers and associated components suitable for operation under the following service conditions without derating:

a. Altitude:
1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
b. Ambient Temperature: Between 32 degrees F and 104 degrees F.

2. Provide motor controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:
1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:
1. Comply with NEMA ICS 6.
2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
3. Finish: Manufacturer's standard unless otherwise indicated.

H. Instrument Transformers:
1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

I. Manual Motor Starters:
1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
2. Configuration: Non-reversing unless otherwise indicated.
3. Fractional-Horsepower Manual Motor Starters:
a. Furnish with toggle operator.
b. Overload Relays: Bimetallic or melting alloy thermal type.
c. Furnish Red ON indicating light.

2.02 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
a. Employ manual reset unless otherwise indicated.
b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
a. Interchangeable current elements/heaters.
b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
c. Trip test function.
7. Melting Alloy Thermal Overload Relays:

a. Interchangeable current elements/heaters.

B. Fusible Disconnect Switches:
1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

C. Circuit Breakers:
1. Interrupting Capacity (not applicable to motor circuit protectors):
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Molded Case Circuit Breakers:
a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 05 26.

G. Install all field-installed devices, components, and accessories.

H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

D. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than _____ amperes. Tests listed as optional are not required.

F. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

3.04 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.05 PROTECTION

A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION

"General Decision Number: RI20210001 09/17/2021

Superseded General Decision Number: RI20200001

State: Rhode Island

Construction Types: Building, Heavy (Heavy and Marine) and Highway

Counties: Rhode Island Statewide.

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories) HEAVY, HIGHWAY AND MARINE CONSTRUCTION PROJECTS

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	01/22/2021
2	03/05/2021
3	04/09/2021
4	04/23/2021
5	06/18/2021
6	07/30/2021
7	09/10/2021
8	09/17/2021

ASBE0006-006 12/01/2019

	Rates	Fringes
HAZARDOUS MATERIAL HANDLER (Includes preparation, wetting, stripping, removal scrapping, vacuuming, bagging & disposing of all insulation materials, whether they		

contain asbestos or not, from
mechanical systems).....$ 36.60 22.40

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* ASBE0006-008 09/01/2021

	Rates	Fringes
Asbestos Worker/Insulator Includes application of all insulating materials, protective coverings, coatings & finishes to all types of mechanical systems.	$ 45.00	32.89

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* BOIL0029-001 01/01/2021

	Rates	Fringes
BOILERMAKER	$ 45.87	29.02

BRRI0003-001 06/01/2020

	Rates	Fringes
Bricklayer, Stonemason, Pointer, Caulker & Cleaner	$ 42.55	28.02

BRRI0003-002 03/01/2020

	Rates	Fringes
Marble Setter, Terrazzo Worker & Tile Setter	$ 40.78	28.92

BRRI0003-003 03/01/2020

	Rates	Fringes
Marble, Tile & Terrazzo Finisher	$ 34.10	27.88

CARP0330-001 01/01/2021

	Rates	Fringes
CARPENTER (Includes Soft Floor Layer)	$ 39.72	28.66
Diver Tender	$ 40.72	28.66
DIVER	$ 51.47	28.66
Piledriver	$ 39.72	28.66
WELDER	$ 40.72	28.66

FOOTNOTES:

When not diving or tending the diver, the diver and diver tender shall receive the piledriver rate. Diver tenders shall receive $1.00 per hour above the pile driver rate when tending the diver.

Work on free-standing stacks, concrete silos & public utility electrical power houses, which are over 35 ft. in height when constructed: $.50 per hour additional.

Work on exterior concrete shear wall gang forms, 45 ft. or more above ground elevation or on setback: $.50 per hour

additional.

The designated piledriver, known as the ""monkey"": $1.00 per hour additional.

CARP1121-002 01/06/2020

	Rates	Fringes
MILLWRIGHT	$ 39.07	29.15

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* ELEC0099-002 06/02/2021

	Rates	Fringes
ELECTRICIAN	$ 43.61	54.71%
Teledata System Installer	$ 32.71	12.57%+14.93

FOOTNOTES:

Work of a hazardous nature, or where the work height is 30 ft. or more from the floor, except when working OSHA-approved lifts: 20% per hour additional.

Work in tunnels below ground level in combined sewer outfall: 20% per hour additional.

ELEV0039-001 01/01/2021

	Rates	Fringes
ELEVATOR MECHANIC	$ 55.03	35.825+A+B

FOOTNOTES:

A. PAID HOLIDAYS: New Years Day; Memorial Day; Independence Day; Labor Day; Veterans' Day; Thanksgiving Day; the Friday after Thanksgiving Day; and Christmas Day.

B. Employer contributes 8% basic hourly rate for 5 years or more of service of 6% basic hourly rate for 6 months to 5 years of service as vacation pay credit.

ENGI0057-001 12/01/2020

	Rates	Fringes
Operating Engineer: (power plants, sewer treatment plants, pumping stations, tunnels, caissons, piers, docks, bridges, wind turbines, subterranean & other marine and heavy construction work)		
GROUP 1	$ 42.55	27.70+a
GROUP 2	$ 40.55	27.70+a
GROUP 3	$ 36.17	27.70+a
GROUP 4	$ 33.32	27.70+a
GROUP 5	$ 39.60	27.70+a
GROUP 6	$ 30.40	27.70+a
GROUP 7	$ 24.40	27.70+a

GROUP 8.....$ 36.25 27.70+a
GROUP 9.....$ 40.17 27.70+a

a. BOOM LENGTHS, INCLUDING JIBS:

150 feet and over + $ 2.00
180 feet and over + $ 3.00
210 feet and over + $ 4.00
240 feet and over + $ 5.00
270 feet and over + $ 7.00
300 feet and over + $ 8.00
350 feet and over + $ 9.00
400 feet and over + $10.00

a. PAID HOLIDAYS:
New Year's Day, President's Day, Memorial Day, July Fourth, Victory Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day, Christmas Day. a: Any employee who works 3 days in the week in which a holiday falls shall be paid for the holiday.

a. FOOTNOTES:
Hazmat work: $2.00 per hour additional.
Tunnel/Shaft work: $5.00 per hour additional.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, lighters, boom trucks and derricks

GROUP 2: Digging machine, Ross Carrier, locomotive, hoist, elevator, bidwell-type machine, shot & water blasting machine, paver, spreader, graders, front end loader (3 yds. and over), vibratory hammer & vacuum truck, roadheaders, forklifts, economobile type equipment, tunnel boring machines, concrete pump and on site concrete plants.

GROUP 3: Oilers on cranes.

GROUP 4: Oiler on crawler backhoe.

GROUP 5: Bulldozer, bobcats, skid steer loader, tractor, scraper, combination loader backhoe, roller, front end loader (less than 3 yds.), street and mobile-powered sweeper (3-yd. capacity), 8-ft. sweeper minimum 65 HP).

GROUP 6: Well-point installation crew.

GROUP 7: Utility Engineers and Signal Persons

GROUP 8: Heater, concrete mixer, stone crusher, welding machine, generator and light plant, gas and electric driven pump and air compressor.

GROUP 9: Boat & tug operator.

ENGI0057-002 11/01/2020

	Rates	Fringes
Power Equipment Operator (highway construction projects; water and sewerline projects which are incidental		

to highway construction
projects; and bridge projects
that do not span water)

GROUP 1	$ 35.70	27.70+a
GROUP 2	$ 30.40	27.70+a
GROUP 3	$ 24.40	27.70+a
GROUP 4	$ 30.98	27.70+a
GROUP 5	$ 34.68	27.70+a
GROUP 6	$ 34.30	27.70+a
GROUP 7	$ 29.95	27.70+a
GROUP 8	$ 31.33	27.70+a
GROUP 9	$ 33.28	27.70+a

a. FOOTNOTE: a. Any employee who works three days in the week in which a holiday falls shall be paid for the holiday.

a. PAID HOLIDAYS: New Year's Day, President's Day, Memorial Day, July Fourth, Victory Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day & Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Digging machine, crane, piledriver, lighter, locomotive, derrick, hoist, boom truck, John Henry's, directional drilling machine, cold planer, reclaimer, paver, spreader, grader, front end loader (3 yds. and over), vacuum truck, test boring machine operator, veemere saw, water blaster, hydro-demolition robot, forklift, economobile, Ross Carrier, concrete pump operator and boats

GROUP 2: Well point installation crew

GROUP 3: Utlity engineers and signal persons

GROUP 4: Oiler on cranes

GROUP 5: Combination loader backhoe, front end loader (less than 3 yds.), forklift, bulldozers & scrapers and boats

GROUP 6: Roller,skid steer loaders, street sweeper

GROUP 7: Gas and electric drive heater, concrete mixer, light plant, welding machine, pump & compressor

GROUP 8: Stone crusher

GROUP 9: Mechanic & welder

ENGI0057-003 12/01/2020

BUILDING CONSTRUCTION

	Rates	Fringes
Power Equipment Operator		
GROUP 1	$ 41.82	27.70+a
GROUP 2	$ 39.82	27.70+a
GROUP 3	$ 39.60	27.70+a
GROUP 4	$ 35.60	27.70+a
GROUP 5	$ 32.75	27.70+a
GROUP 6	$ 38.90	27.70+a
GROUP 7	$ 38.47	27.70+a
GROUP 8	$ 35.79	27.70+a

a.BOOM LENTHS, INCLUDING JIBS:

150 ft. and over: + $ 2.00
180 ft. and over: + $ 3.00
210 ft. and over: + $ 4.00
240 ft. and over: + $ 5.00
270 ft. and over: + $ 7.00
300 ft. and over: + $ 8.00
350 ft. and over: + $ 9.00
400 ft. and over: + $10.00

a. PAID HOLIDAYS: New Year's Day, President's Day, Memorial Day, July Fourth, Victory Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day & Christmas Day. a: Any employee who works 3 days in the week in which a holiday falls shall be paid for the holiday.

a. FOOTNOTE: Hazmat work: $2.00 per hour additional.
Tunnel/Shaft work: $5.00 per hour additional.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, lighters, boom trucks and derricks.

GROUP 2: Digging machine, Ross carrier, locomotive, hoist, elevator, bidwell-type machine, shot & water blasting machine, paver, spreader, front end loader (3 yds. and over), vibratory hammer and vacuum truck

GROUP 3: Telehandler equipment, forklift, concrete pump & on-site concrete plant

GROUP 4: Fireman & oiler on cranes

GROUP 5: Oiler on crawler backhoe

GROUP 6: Bulldozer,skid steer loaders,bobcats, tractor, grader, scraper,combination loader backhoe, roller, front end loader (less than 3 yds.), street and mobile powered sweeper (3 yds. capacity), 8-ft. sweeper (minimum 65 hp)

GROUP 7: Well point installation crew

GROUP 8: Heater, concrete mixer, stone crusher, welding machine, generator for light plant, gas and electric driven pump & air compressor

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* IRON0037-001 09/16/2021

	Rates	Fringes
IRONWORKER	$ 38.21	30.58

LABO0271-001 05/30/2021

BUILDING CONSTRUCTION

	Rates	Fringes
LABORER		
GROUP 1	$ 33.55	26.15
GROUP 2	$ 33.80	26.15
GROUP 3	$ 34.30	26.15

GROUP 4	$ 34.55	26.15
GROUP 5	$ 35.55	26.15

LABORERS CLASSIFICATIONS

GROUP 1: Laborer, Carpenter Tender, Mason Tender, Cement Finisher Tender, Scaffold Erector, Wrecking Laborer, Asbestos Removal [Non-Mechanical Systems]

GROUP 2: Asphalt Raker, Adzemen, Pipe Trench Bracer, Demolition Burner, Chain Saw Operator, Fence & Guard Rail Erector, Setter of Metal Forms for Roadways, Mortar Mixer, Pipelayer, Riprap & Dry Stonewall Builder, Highway Stone Spreader, Pneumatic Tool Operator, Wagon Drill Operator, Tree Trimmer, Barco-Type Jumping Tamper, Mechanical Grinder Operator

GROUP 3: Pre-Cast Floor & Roof Plank Erectors

GROUP 4: Air Track Operator, Hydraulic & Similar Self-Powered Drill, Block Paver, Rammer, Curb Setter, Powderman & Blaster

GROUP 5: Toxic Waste Remover

LABO0271-002 05/30/2021

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
LABORER		
COMPRESSED AIR		
Group 1	$ 53.45	24.15
Group 2	$ 50.98	24.15
Group 3	$ 40.50	24.15
FREE AIR		
Group 1	$ 44.05	24.15
Group 2	$ 43.05	24.15
Group 3	$ 40.50	24.15
LABORER		
Group 1	$ 33.55	24.15
Group 2	$ 33.80	24.15
Group 3	$ 34.55	24.15
Group 4	$ 27.05	24.15
Group 5	$ 35.55	24.15
OPEN AIR CAISSON, UNDERPINNING WORK AND BORING CREW		
Bottom Man	$ 39.55	24.15
Top Man & Laborer	$ 38.60	24.15
TEST BORING		
Driller	$ 40.00	24.15
Laborer	$ 38.60	24.15

LABORER CLASSIFICATIONS

GROUP 1: Laborer; Carpenter tender; Cement finisher tender; Wrecking laborer; Asbestos removers [non-mechanical systems]; Plant laborer; Driller in quarries

GROUP 2: Adzeperson; Asphalt raker; Barcotype jumping tamper; Chain saw operators; Concrete and power buggy operator; Concrete saw operator; Demolition burner; Fence and guard rail erector; Highway stone spreader; Laser beam

operator; Mechanical grinder operator; Mason tender; Mortar mixer; Pneumatic tool operator; Riprap and dry stonewall builder; Scaffold erector; Setter of metal forms for roadways; Wagon drill operator; Wood chipper operator; Pipelayer; Pipe trench bracer

GROUP 3: Air track drill operator; Hydraulic and similar powered drills; Brick paver; Block paver; Rammer and curb setter; Powderperson and blaster

GROUP 4: Flagger & signaler

GROUP 5: Toxic waste remover

LABORER - COMPRESSED AIR CLASSIFICATIONS

GROUP 1: Mucking machine operator, tunnel laborer, brake person, track person, miner, grout person, lock tender, gauge tender, miner: motor person & all others in compressed air

GROUP 2: Change house attendant, powder watchperson, top person on iron

GROUP 3: Hazardous waste work within the ""HOT"" zone

LABORER - FREE AIR CLASSIFICATIONS

GROUP 1: Grout person - pumps, brake person, track person, form mover & stripper (wood & steel), shaft laborer, laborer topside, outside motorperson, miner, conveyor operator, miner welder, heading motorperson, erecting operator, mucking machine operator, nozzle person, rodperson, safety miner, shaft & tunnel, steel & rodperson, mole nipper, concrete worker, form erector (wood, steel and all accessories), cement finisher (this type of work only), top signal person, bottom person (when heading is 50' from shaft), burner, shield operator and TBM operator

GROUP 2: Change house attendant, powder watchperson

GROUP 3: Hazardous waste work within the ""HOT"" zone

PAIN0011-005 06/01/2021

	Rates	Fringes
PAINTER		
Brush and Roller	$ 36.42	22.90
Epoxy, Tanks, Towers, Swing Stage & Structural Steel	$ 38.42	22.90
Spray, Sand & Water Blasting	$ 39.42	22.90
Taper	$ 37.17	22.90
Wall Coverer	$ 36.92	22.90

PAIN0011-006 06/01/2021

	Rates	Fringes
GLAZIER	$ 39.98	22.90

FOOTNOTES:

SWING STAGE: $1.00 per hour additional.

PAID HOLIDAYS: Labor Day & Christmas Day.

PAIN0011-011 06/01/2021

	Rates	Fringes
Painter (Bridge Work)	$ 54.00	22.90

PAIN0035-008 06/01/2011

	Rates	Fringes
Sign Painter	$ 24.79	13.72

PLAS0040-001 06/03/2019

BUILDING CONSTRUCTION

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 36.00	27.15

FOOTNOTE: Cement Mason: Work on free swinging scaffolds under 3 planks width and which is 20 or more feet above ground and any offset structure: $.30 per hour additional.

PLAS0040-002 07/01/2019

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 32.85	22.20

PLAS0040-003 07/01/2019

	Rates	Fringes
PLASTERER	$ 37.55	27.50

PLUM0051-002 08/30/2021

	Rates	Fringes
Plumbers and Pipefitters	$ 46.49	31.40

ROOF0033-004 06/01/2021

	Rates	Fringes
ROOFER	$ 39.40	29.06

SFRI0669-001 04/01/2021

	Rates	Fringes
SPRINKLER FITTER	$ 47.55	26.60

SHEE0017-002 12/01/2020

	Rates	Fringes
Sheet Metal Worker.....	$ 38.58	36.73

TEAM0251-001 05/01/2019

HEAVY AND HIGHWAY CONSTRUCTION

	Rates	Fringes
TRUCK DRIVER		
GROUP 1.....	$ 27.96	26.8525+A+B+C
GROUP 2.....	$ 27.61	26.8525+A+B+C
GROUP 3.....	$ 27.66	26.8525+A+B+C
GROUP 4.....	$ 27.71	26.8525+A+B+C
GROUP 5.....	$ 27.81	26.8525+A+B+C
GROUP 6.....	$ 28.21	26.8525+A+B+C
GROUP 7.....	$ 28.41	26.8525+A+B+C
GROUP 8.....	$ 27.91	26.8525+A+B+C
GROUP 9.....	$ 28.16	26.8525+A+B+C
GROUP 10.....	$ 27.96	26.8525+A+B+C

FOOTNOTES:

A. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, plus Presidents' Day, Columbus Day, Veteran's Day & V-J Day, providing the employee has worked at least one day in the calendar week in which the holiday falls.

B. Employee who has been on the payroll for 1 year or more but less than 5 years and has worked 150 Days during the last year of employment shall receive 1 week's paid vacation; 5 to 10 years - 2 weeks' paid vacation; 10 or more years - 3 week's paid vacation.

C. Employees on the seniority list shall be paid a one hundred dollar ($100.00) bonus for every four hundred (400) hours worked, up to a maximum of five hundred dollars ($500.00)

All drivers working on a defined hazard material job site shall be paid a premium of $2.00 per hour over applicable rate.

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Pick-up trucks, station wagons, & panel trucks

GROUP 2: Two-axle on low beds

GROUP 3: Two-axle dump truck

GROUP 4: Three-axle dump truck

GROUP 5: Four- and five-axle equipment

GROUP 6: Low-bed or boom trailer.

GROUP 7: Trailers when used on a double hook up (pulling 2 trailers)

GROUP 8: Special earth-moving equipment, under 35 tons

GROUP 9: Special earth-moving equipment, 35 tons or over

GROUP 10: Tractor trailer

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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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.

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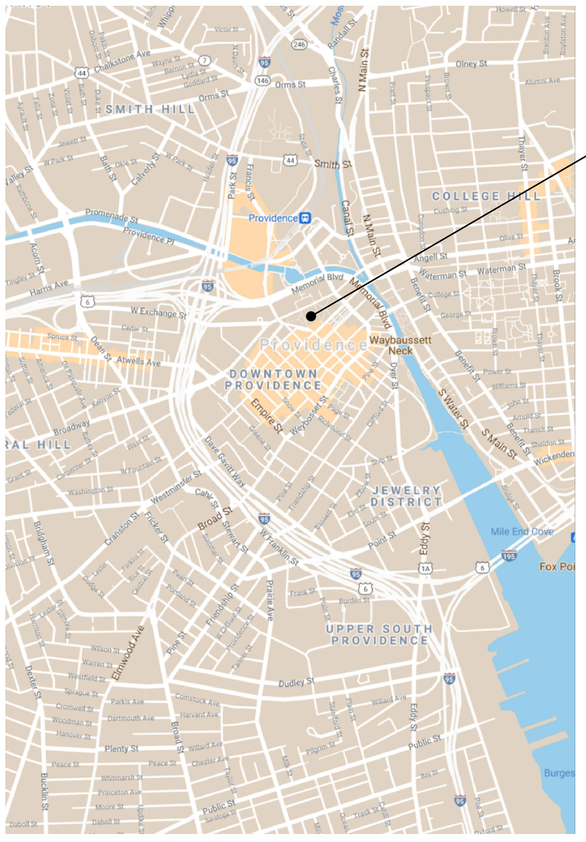
END OF GENERAL DECISION"



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RETHINKING POWER MANAGEMENT
HVAC UPGRADES
AT THE
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

SHEET INDEX

SHEET NUMBER	SHEET TITLE
GENERAL	
G-000	PROJECT COVER SHEET
ARCHITECTURAL	
A-101	ARCHITECTURAL PLANS
MECHANICAL	
M-000	MECHANICAL COVER SHEET
M-101	MECHANICAL PLANS
ELECTRICAL	
E-000	ELECTRICAL COVER SHEET
E-101	ELECTRICAL PLANS

PROJECT LOCATION MAPS

LOCATION MAP

PROJECT LOCATION
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

CITY CENTER ICE RINK

SITE

AREA MAP

SITE MAP

CODE INFORMATION

1. APPLICABLE CODES AND STANDARDS

2015 IBC w/ RHODE ISLAND AMENDMENTS
2015 IMC w/ RHODE ISLAND AMENDMENTS
2015 IPC w/ RHODE ISLAND AMENDMENTS
2015 NFPA 1 w/ RHODE ISLAND AMENDMENTS dated 2019 02 25
2015 NFPA 101 w/ RHODE ISLAND AMENDMENTS dated 2019 02 25
2010 ADA STANDARDS FOR ACCESSIBLE DESIGN
2009 ICC A117.1

2. PROJECT DATA

OWNER: RETHINKING POWER MANAGEMENT

LOCATION: CITY CENTER ICE RINK

ADDRESS: 2 KENNEDY PLAZA, PROVIDENCE, RI 02903

OCCUPANCY CLASSIFICATION: B

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MARYLAND OFFICE
213 FRONT STREET, P.O. BOX 254
CRUMPTON, MARYLAND 216285

CONSULTANT

ARCHITECT / ENGINEER SEAL

PROJECT

RETHINKING POWER MANAGEMENT
HVAC UPGRADES
AT THE
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

REVISIONS

MARK	DESCRIPTION	DATE
-	-	-

SHEET TITLE

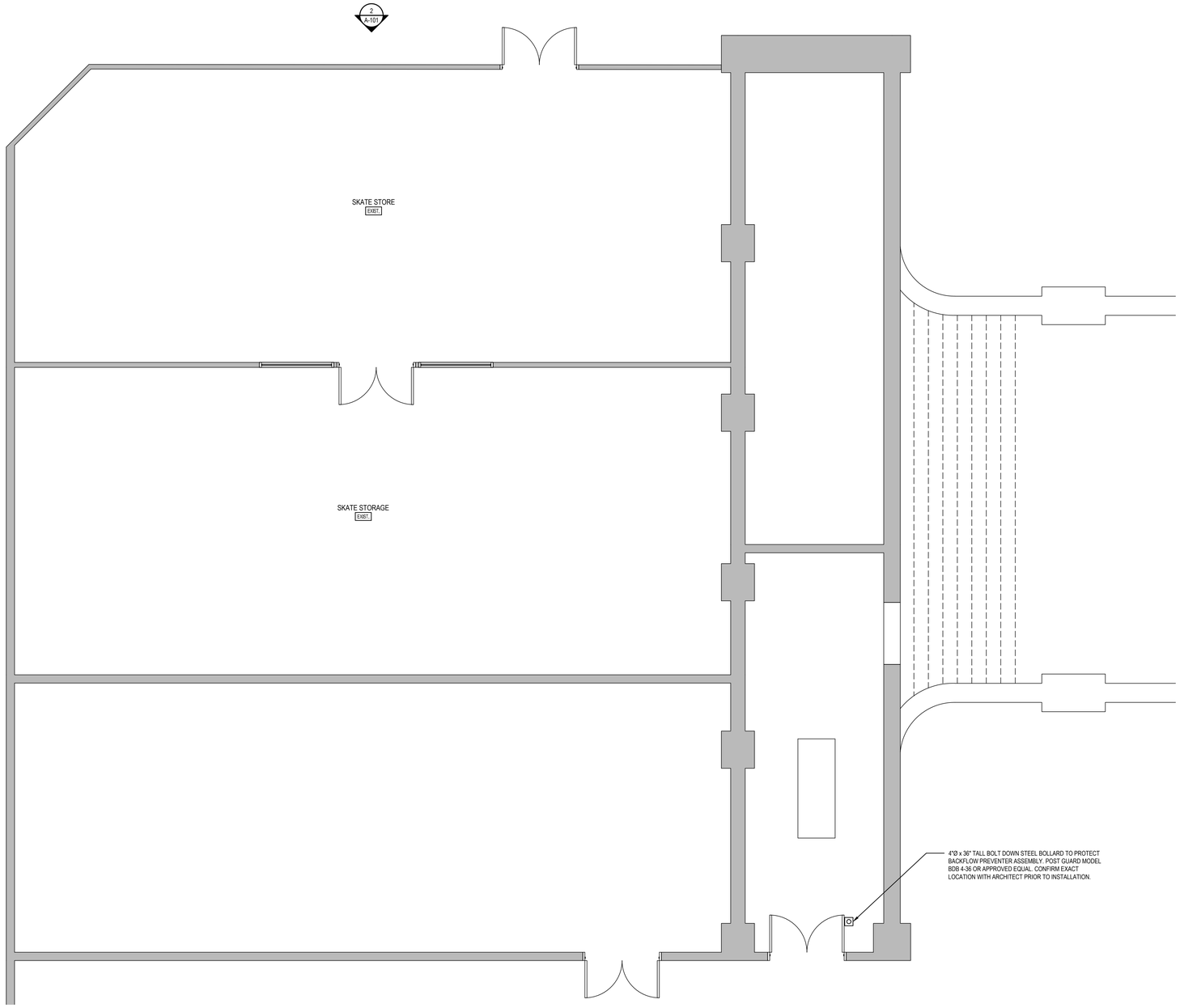
PROJECT COVER SHEET

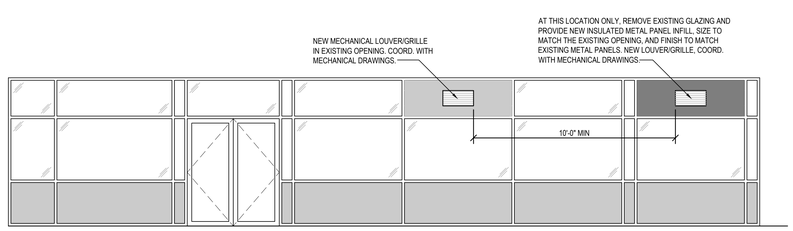
OWNER
REVIEW
9/9/2021

DRAWN	CHK'D	PROJECT NO.
TMC	BMZ	21073

SHEET NO.

G-000





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4"Ø x 36" TALL BOLT DOWN STEEL BOLLARD TO PROTECT BACKFLOW PREVENTER ASSEMBLY. POST GUARD MODEL BDB 4-36 OR APPROVED EQUAL. CONFIRM EXACT LOCATION WITH ARCHITECT PRIOR TO INSTALLATION.

1
A-101

EXISTING FLOOR PLAN

SCALE: 1/4" = 1'-0"

NEW MECHANICAL LOUVER/GRILLE IN EXISTING OPENING. COORD. WITH MECHANICAL DRAWINGS.

AT THIS LOCATION ONLY, REMOVE EXISTING GLAZING AND PROVIDE NEW INSULATED METAL PANEL INFILL, SIZE TO MATCH THE EXISTING OPENING, AND FINISH TO MATCH EXISTING METAL PANELS. NEW LOUVER/GRILLE, COORD. WITH MECHANICAL DRAWINGS.

2
A-101

STOREFRONT ELEVATION

SCALE: 1/4" = 1'-0"

METAL PANEL SPECIFICATIONS:

INFILL PANELS - LAMINATED
1. LAMINATED METAL FACED MAPES-R PANELS AS MANUFACTURED BY MAPES INDUSTRIES, INC.

FINISH
1. EXTERIOR: STANDARD KYNAR
2. INTERIOR: STANDARD KYNAR
3. COLOR AS SELECTED BY OWNER

PANEL FABRICATION
1. EXTERIOR SUBSTRATE: TEMPERED HARDBOARD
2. CORE: POLYSTYRENE
3. INTERIOR SUBSTRATE: TEMPERED HARDBOARD
4. TOLERANCES - .8% OF PANELS DIMENSION LENGTH AND WIDTH - (+/-) 1/16" THICKNESS
5. PANEL THICKNESS - 1"
6. R-VALUE - 4.68
7. U-VALUE - 0.21

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THE PROFESSIONAL SERVICES OF THE ARCHITECT ARE UNDERTAKEN FOR AND ARE PERFORMED IN THE INTEREST OF [NAME OF PERSON EMPLOYING ARCHITECT]. NO CONTRACTUAL OBLIGATION IS ASSUMED BY THE ARCHITECT FOR THE BENEFIT OF ANY OTHER PERSON INVOLVED IN THE PROJECT.

SIGNATURE: ____________________
DATE OF SIGNATURE: ____________________
DATE OF REGISTRATION EXPIRATION: __________

ARCHITECT / ENGINEER SEAL

PROJECT

RETHINKING POWER MANAGEMENT
HVAC UPGRADES
AT THE
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

REVISIONS

MARK	DESCRIPTION	DATE
-	-	-

SHEET TITLE

ARCHITECTURAL PLANS

OWNER
REVIEW
9/9/2021

DRAWN	CHK'D	PROJECT NO.
BF	BMZ	21073

SHEET NO.

A-101

9/9/2021 3:12 PM

GENERAL HVAC NOTES

1. ALL NEW SUPPLY AIR DIFFUSERS AND RETURN AIR REGISTERS SHALL BE EQUIPPED W/ MFGR. SUPPLIED VOLUME DAMPERS.
2. FIRE DAMPERS SHALL BE PLACED IN ALL DUCT OR TRANSFER AIR PENETRATIONS OF ALL FIRE RATED PARTITIONS. SEE ARCHITECTURAL DRAWINGS FOR FIRE RATED PARTITIONS. PROVIDE LABELED ACCESS DOORS AS NEEDED. FIRE DAMPERS AND INSTALLATION ARE TO BE IN ACCORDANCE WITH THE 2018 INTERNATIONAL MECHANICAL CODE.
3. DUCT SMOKE DETECTORS ARE TO BE SUPPLIED AND INSTALLED WHERE SHOWN IN ACCORDANCE WITH NFPA 72. ACCESS SHALL BE PROVIDED TO SMOKE DETECTORS FOR INSPECTION AND MAINTENANCE. ELECTRICAL CONTRACTOR SHALL MAKE APPROPRIATE AND REQUIRED ELECTRICAL CONNECTIONS TO THE DUCT SMOKE DETECTORS AS SPECIFIED AND REQUIRED FOR PROPER OPERATION. DUCT SMOKE DETECTORS SHALL DE-ENERGIZE THE AIR HANDLING UNIT, OR EXHAUST FAN, THAT THEY ARE ASSOCIATED WITH AND ACTIVATE A VISIBLE AND AUDIBLE SUPERVISORY SIGNAL IN THE BUILDING'S FIRE PROTECTIVE SIGNALING SYSTEM AT A CONSTANTLY ATTENDED LOCATION. ANY SYSTEM THAT IS DE-ENERGIZED BY THE ALARM SHALL NOT RESTART EXCEPT BY MANUAL RESET ON THE UNIT R THROUGH THE BAC SYSTEM. SMOKE DETECTORS SHALL COMPLY WITH THE 2018 INTERNATIONAL MECHANICAL CODE IN ENTIRETY.
4. PIPES, BUS DUCTS, CABLES, WIRES, AIR DUCTS AND SIMILAR BUILDING SERVICE EQUIPMENT THAT PASS THROUGH SMOKE PARTITIONS SHALL BE PROTECTED AS STATED IN NFPA 101 CHAPTER 6-3.6. THE SPACE BETWEEN THE PENETRATING PIPE OR DUCT AND THE SMOKE BARRIER SHALL:

   A. BE FILLED WITH A MATERIAL CAPABLE OF MAINTAINING THE SMOKE-RESISTANCE OF THE SMOKE BARRIER OR

   B. BE PROTECTED BY AN APPROVED DEVICE DESIGNED FOR THE SPECIFIC PURPOSE.

   INSULATION AND COVERINGS FOR PIPES AND DUCTS SHALL NOT PASS THROUGH FIRE BARRIERS UNLESS ONE OF THESE REQUIREMENTS IS MET. CONTRACTOR IS RESPONSIBLE FOR CHOOSING WHICH ALTERNATIVE TO USE UNLESS OTHERWISE SPECIFIED IN THE DRAWINGS OR SPECIFICATIONS.
5. INSULATE ALL NEW DUCTWORK AND EQUIPMENT, AS SPECIFIED UNLESS OTHERWISE NOTED. ALL NON-FLEXIBLE DUCTWORK SHALL BE METAL. DUCTBOARD IS PROHIBITED.
6. PROVIDE AND INSTALL ALL GAUGES AND METERS AS SHOWN AND SPECIFIED.
7. MFGR'S OF ALL COILS SHALL ENSURE THAT THE COILS ARE CLEAN AND FREE OF ANY RESIDUE FROM THE MANUFACTURING AND SHIPPING PROCESS. IF COILS ARE FOUND TO BE DIRTY OR SMOKE WHEN HOT WATER IS PROVIDED TO THEM, THE CONTRACTOR WILL BE RESPONSIBLE FOR CLEANING OF THE COILS, AS WELL AS, CLEANING THE BUILDING FROM SMOKE, COIL EMANATIONS, OR VAPORS.
8. ALL DUCTS SHALL BE CONNECTED TO AIR OUTLETS, AIR INLETS, AND AIR HANDLING DEVICES TO PROVIDE A COMPLETE DUCTWORK SYSTEM. FOR CONNECTION TO AIR OUTLETS UP TO 5 FEET OF FLEX DUCT SHALL BE USED WHERE CONCEALED FROM OCCUPANT VIEW. CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL TRANSITIONS TO ENSURE PROPER AND ADEQUATE CONNECTIONS OF ALL DUCTWORK TO ALL AIR INLETS, OUTLETS, AIR HANDLING DEVICES AND AIR TERMINAL DEVICES. DUCTWORK IS TO BE COORDINATED WITH TRANSFER AIR OPENINGS AND ROOF TRUSS SYSTEM, OR STRUCTURAL STEEL.
9. THE RETURN AIRFLOWS INDICATED ON THE PLANS CORRESPOND TO THE OCCUPIED MODE WITH MINIMUM OUTSIDE AIR BEING SUPPLIED. THE BALANCE REPORT IS TO INDICATE THESE AIRFLOWS IN THIS MODE OF OPERATION.
10. GRAVITY VENTILATORS, ROOF EXHAUSTERS AND ASSOCIATED DUCTWORK CONNECTIONS ARE TO BE COORDINATED WITH BUILDING STRUCTURAL COMPONENTS.
11. HVAC EQUIPMENT SHALL BE FURNISHED WITH A MOTOR STARTER SUITABLE FOR THE OFF-ON CONTROL OF THE MOTOR BY A REMOTE THERMOSTAT OR BAS CONTACT. THESE STARTERS SHALL COMPLY WITH NATIONAL ELECTRIC CODE.
12. ALL AIR HANDLING UNITS ARE TO BE INSTALLED TO PROVIDE ADEQUATE, UNOBSTRUCTED, ACCESS AND CLEARANCE FOR AIR FILTER REPLACEMENT.
13. ALL MOTORS FURNISHED AND INSTALLED BY THE MECHANICAL CONTRACTOR (OR A MECHANICAL SUBCONTRACTOR) SHALL BE PROTECTED AGAINST OVERLOAD IN ACCORDANCE WITH N.E.C. ARTICLE 430, SECTION C.
14. WHERE DEMOLISHING AND REMOVING UV'S, REMOVE ASSOCIATED LOUVER. CONTRACTOR MUST PATCH AND PAINT TO MATCH EXISTING SURROUNDINGS.
15. VENTS AND PLUMBING VENTS SHALL BE LOCATED A MINIMUM OF 10' FROM ANY INTAKE AIR OPENING.
16. MECHANICAL EQUIPMENT AND DEVICES SHALL OPERATE WITHOUT OBJECTIONABLE NOISE AND VIBRATION BEING TRANSMITTED TO OCCUPIED PORTIONS OF THE BUILDING OR ANY PART OF THE BUILDING STRUCTURE BY APPARATUS, PIPING, DUCTWORK, CONDUITS, OR OTHER PARTS OF THE MECHANICAL SYSTEM. SECURE AND BRACE ALL PIPING AND DUCTWORK, PROVIDE FLEXIBLE CONNECTION, VIBRATION ISOLATORS, OR OTHER DEVICES WHERE INDICATED OR REQUIRED TO PREVENT THE TRANSMISSION OF NOISE AND VIBRATION TO THE BUILDING. NC LEVEL IS 35.
17. ALL NEW CEILING MOUNTED AIR INLETS AND AIR OUTLETS ARE TO BE COORDINATED WITH LIGHTING. A NEAT, SYMMETRICAL INSTALLATION IS TO BE MAINTAINED, WITH CEILING MOUNTED AIR INLETS/OUTLETS IN PROXIMITY TO LOCATIONS SHOWN ON THE PLANS. IN THE CASE THAT THERE IS A CONFLICT, THE LOCATION OF THE LIGHTING WILL TAKE PRIORITY AND THE INLET/OUTLET SHALL BE RELOCATED AS CLOSE AS POSSIBLE. DUCTWORK SHOP DRAWINGS ARE TO SHOW PLACEMENT OF AIR INLETS/OUTLETS WITH LIGHTING OVERLAID ON THE SAME PLAN. CONTRACTORS ARE TO USE REFLECTED CEILING PLAN AS BASIS FOR COORDINATION.
18. THE CONTRACTOR SHALL PROVIDE ALL WALL AND ROOF PENETRATIONS REQUIRED FOR DUCT ROUTING. THE CONTRACTOR SHALL PATCH AND PAINT ALL PENETRATIONS LEFT BY DEMOLITION WORK AND BY CLEARANCE OPENINGS THAT REMAIN AFTER NEW DUCT INSTALLATIONS.
19. NOTIFY THE OWNER IN THE EVENT ANY EXISTING HAZARDOUS MATERIALS, SUCH AS ASBESTOS, PCB'S, LEAD, ETC., ARE ENCOUNTERED ON THE PROJECT. THE OWNER WILL ARRANGE WITH A QUALIFIED SPECIALIST FOR THE IDENTIFICATION, TESTING, REMOVAL, HANDLING AND PROTECTION AGAINST EXPOSURE OR ENVIRONMENTAL POLLUTION, TO COMPLY WITH APPLICABLE REGULATIONS, LAWS AND ORDINANCES.
20. ALL THERMOSTATS SHOWN ON HVAC PLANS ARE TO BE MOUNTED 4'-0" MAXIMUM AFF (TOP OF UNIT), UNLESS NOTED OTHERWISE. CONTRACTOR IS RESPONSIBLE FOR MOUNTING & WIRING ALL THERMOSTATS. PLENUM RATED CABLES MUST BE USED.
21. VARIABLE FREQUENCY DRIVES (VFD) SHALL BE CONSIDERED SYNONYMOUS WITH ADJUSTABLE FREQUENCY DRIVES (AFD).
22. THE CONTRACTOR SHALL PROVIDE RADIUSED ELBOWS OR SQUARE THROAT ELBOWS WITH VANES FOR ALL DUCTWORK CHANGES IN DIRECTION, PER SMACNA HVAC DUCT CONSTRUCTION STANDARDS METAL AND FLEXIBLE. SQUARE THROAT ELBOWS WITHOUT VANES AND MITERED ELBOWS ARE NOT PERMITTED.
23. ALL BLOWER COILS UNITS ARE TO HAVE 24" MINIMAL CLEARANCE ON ACCESS SIDE COORDINATE UNIT SUSPENSION WITH STRUCTURE.
24. ALL GANG TOILET ROOM DOORS ARE TO BE UNDERCUT TO PROVIDE 0.75" CLEARANCE BETWEEN BOTTOM OF DOOR AND FINISHED FLOOR.
25. HANG ALL CEILING MOUNTED UNITS HIGH TO ALLOW FOR CONDENSATE TRAPPING AND GRAVITY VENTS.
26. ALL QUANTITIES TO BE VERIFIED BY CONTRACTOR.
27. PRIOR TO SUBMITTING BID, THE CONTRACTOR SHALL VISIT THE SITE AND BE THOROUGHLY FAMILIAR WITH THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION. CONTRACTOR SHALL INCLUDE IN THEIR BID ALL MATERIALS, LABOR AND ALL INCIDENTALS FOR A COMPLETE INSTALLATION WHETHER SPECIFICALLY INDICATED OR NOT. ALL ERRORS, DISCREPANCIES AND MISSED ITEMS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER DURING THE BIDDING PROCESS BY THE CONTRACTOR. THESE ITEMS SHALL BE INCLUDED IN THE BID PRICE. NO EXTRA COST WILL BE ALLOWED FOR ANY DISCREPANCY WHICH COULD HAVE BEEN NOTICED AT THE SITE BY THE CONTRACTOR.
28. INSTALL ALL EQUIPMENT AND MATERIALS PER MANUFACTURER'S WRITTEN INSTRUCTION.
29. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ADDITIONAL COSTS INCURRED AS A RESULT OF SUBSTITUTIONS OR DEVIATIONS FROM THE BASIS OF DESIGN SHOWN ON THESE DRAWINGS.
30. CONTROLS ARE TO BE EXTENDED TO ALL EXISTING, REUSED MECHANICAL EQUIPMENT, INCLUDING EXISTING UNIT VENTILATORS AND EXHAUST FANS. THESE ARE TO BE TIED INTO AND CONTROLLED BY THE NEW BAS SYSTEM.
31. CONTRACTOR IS RESPONSIBLE FOR PROVIDING TRANSITIONS AND FLEXIBLE CONNECTIONS BETWEEN ALL UNITS AND SUPPLY, RETURN, OR OUTSIDE AIR DUCTS.
32. CONTRACTOR SHALL PROVIDE NEW DANFOSS OR APPROVED EQUAL VALVES FOR ALL HEAT ONLY COILS.
33. CONTRACTOR SHALL VERIFY THAT ALL EXISTING EQUIPMENT TO BE REUSED IS IN WORKING ORDER.
34. INSTALL REMOTE EMERGENCY SHUTDOWN SWITCH FOR BOILERS ADJACENT TO EACH BOILER ROOM DOOR.

HVAC LEGEND

- EXISTING DUCTWORK OR EQUIPMENT
- ROUND RETURN OR EXHAUST AIR DOWN
- ROUND SUPPLY AIR DOWN
- ROUND RETURN OR EXHAUST AIR UP
- ROUND SUPPLY AIR UP
- RECTANGULAR RETURN OR EXHAUST AIR DOWN
- RECTANGULAR SUPPLY AIR DOWN
- RECTANGULAR RETURN OR EXHAUST AIR UP
- RECTANGULAR SUPPLY AIR UP
- NEW FLEX DUCTWORK
- D - ? / ??? CFM — CEILING MOUNTED SUPPLY AIR DIFFUSER
- D - ? / ??? CFM — SIDE-WALL MOUNTED SUPPLY AIR DIFFUSER
- D - ? / ??? CFM — CEILING MOUNTED RETURN AIR REGISTER
- D - ? / ??? CFM — SIDE-WALL MOUNTED RETURN AIR REGISTER
- VOLUME DAMPER
- MOD — MOTOR OPERATED DAMPER
- CBBD — COUNTER BALANCED BACKDRAFT DAMPER
- T — THERMOSTAT
- S — DUCT SMOKE DETECTOR
- EXTENT OF WORK
- O.E.D. — OPEN END DUCT
- ERV - ? — ENERGY RECOVERY VENTILATOR
- UH - ? — UNIT HEATER
- L - ? — LOUVER
- B - ? — BOILER

GENERAL PIPING NOTES

1. INSTALL ALL GAUGES AND METERS AS SHOWN ON DRAWINGS AND AS SPECIFIED.
2. INSULATE ALL PIPING AS SPECIFIED.
3. UNLESS OTHERWISE SHOWN OR SPECIFIED, ALL CONDENSATE DRAINS FROM ALL HVAC UNITS SHALL BE TRAPPED AND PIPED THROUGH THE BUILDING AND DRAINED THROUGH THE EXTERIOR WALL OF THE BUILDING AT A HEIGHT NOT TO EXCEED 18" ABOVE GRADE. PIPE SIZES SHALL MATCH SIZE OF DRAIN CONNECTION AT A MINIMUM. UNIT DRAINS SHALL NOT BE GANGED TOGETHER UNLESS APPROVED BY ARCHITECT/ENGINEER. UNLESS OTHERWISE SHOWN OR STATED, CONDENSATE PIPING SHALL NOT BE EXPOSED.
4. ALL FLOOR PENETRATIONS SHALL BE SLEEVED AND SEALED AS SPECIFIED.
5. THE CONTRACTOR IS RESPONSIBLE FOR ALL NEW PIPING PENETRATIONS IN WALLS AND FLOORS. THE PIPING PLANS DO NOT SPECIFICALLY NOTE WHERE PIPING PENETRATES WALLS AND FLOORS. IT IS THE CONTRACTOR'S RESPONSIBILITY PRIOR TO BID TO STUDY THE PLANS AND IF NECESSARY EVALUATE THE SITE, TO ACCOUNT FOR ALL PIPING PENETRATIONS OF THE EXISTING STRUCTURE.
6. THE CONTRACTOR SHALL PROVIDE NEW SUPPORTS OF COMPATIBLE MATERIAL FOR ALL NEW PIPING.
7. PROVIDE NEW DUAL TEMPERATURE WATER SUPPLY AND RETURN PIPING SYSTEM, TO THE EXTENT SPECIFIED AND SHOWN ON CONTRACT DRAWINGS.
8. PROVIDE CHILLED WATER SUPPLY AND RETURN SYSTEM, DOMESTIC WATER DISTRIBUTION SYSTEM, DOMESTIC HOT WATER SUPPLY AND RETURN SYSTEM TO THE EXTENT SHOWN ON PLAN DRAWINGS AND IN DETAILS.
9. ALL CONTROL VALVES TO BE INSTALLED OVER DRAIN PANS IN HVAC UNITS.
10. ALL PIPING SHALL BE SIZED AS CALLED OUT ON DRAWINGS, AND MAY NOT BE DOWN SIZED BETWEEN CONTROL VALVE AND COIL.
11. ALL GAS PIPING IS TO BE INSTALLED PER NFPA 54, AND ALL LOCAL AND NATIONAL CODES.
12. BEFORE ANY SYSTEM OF GAS PIPING IS FINALLY PUT IN SERVICE, IT SHALL BE TESTED TO ENSURE THAT IT IS GAS TIGHT. TO TEST FOR TIGHTNESS, THE PIPING SHALL BE FILLED WITH AIR OR AN INERT GAS, BUT NOT WITH ANY OTHER GAS OR LIQUID. TESTING, INSPECTION AND PURGING OF GAS PIPING SYSTEMS SHALL COMPLY WITH NFPA 54.
13. GAS PIPING ROUTED AT GROUND LEVEL IS TO SIT IN PIPING SADDLES, AND NOT TO BE IN CONTACT WITH CONCRETE OR GROUND.
14. PROVIDE REDUCERS, FITTINGS, AND CONNECTORS TO EQUIPMENT FOR A COMPLETE GAS PIPING INSTALLATION. FITTINGS, JOINTS AND CONNECTIONS SHALL BE OF AN APPROVED TYPE FOR GAS PIPING SYSTEMS.
15. ALL NEW EXPOSED PIPING IN OCCUPIED AREAS SHALL BE ENCLOSED IN CUSTOM FIN TUBE ENCLOSURES OF 14 GA. STEEL. ENCLOSURES SHALL BE BY VULCAN, SHAW-PERKINS, OR TRANE COMPANY. UNITS SHALL BE PAINTED. COLOR SHALL BE SELECTED BY ARCHITECT.
16. PROVIDE AIR VENTS AT ALL HIGH POINTS IN SYSTEM. PROVIDE DRAIN VALVES TO ALL LOW POINTS IN SYSTEM.
17. PROVIDE ISOLATION VALVES AT ALL BRANCH PIPING TAKEOFFS.
18. COORDINATE INSTALLATION OF ALL NEW PIPING WITH EXISTING FIRE PROTECTION PIPING, CONDUIT, EXHAUST/RELIEF DUCT WORK, AND STRUCTURE.
19. PROVIDE SPLASH BLOCKS FOR ALL CONDENSATE DRAINS.
20. FOR CONDENSATE DRAIN PIPING RUNS LONGER THAN 50 FEET, PROVIDE A REMOVABLE PLUG AT A CHANGE OF DIRECTION EVERY 50 FT.

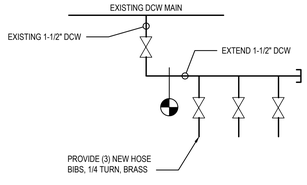
PIPING LEGEND

- HYDRONIC PIPING
- EXISTING HYDRONIC PIPING
- CONDENSATE PIPING
- SHUTOFF VALVE
- BALANCING VALVE
- CHECK VALVE
- ATC 2-WAY CONTROL VALVE
- STRAINER
- FLOW METER FITTING
- T — BAC TEMP SENSOR TO BE CONNECTED TO BAC SYSTEM
- AUTOFLOW 3/4" FLOW LIMITING DEVICE OR APPROVED EQUAL
- CP — CONDENSATE PUMP SYSTEM
- AS - ? — AIR SEPARATOR
- ET - ? — EXPANSION TANK
- P - ? — IN-LINE PUMP
- HWSR — HOT WATER/ SUPPLY AND RETURN
- CW — COLD WATER
- COND — CONDENSATE DRAIN PIPING

MECHANICAL DEMO NOTES & LEGEND

1. ALL DEMOLISHED MECHANICAL UNITS ARE TO BE REMOVED AND TAKEN OFF SITE AND BECOME PROPERTY OF THE CONTRACTOR UNLESS NOTED OTHERWISE.
2. ALL DEMOLISHED DUCTWORK, DIFFUSERS, REGISTERS, GRILLES, INSULATION, AND HANGERS ARE TO BE REMOVED AND TAKEN OFF SITE AND BECOME PROPERTY OF THE CONTRACTOR UNLESS NOTED OTHERWISE.
3. ALL DEMOLISHED HEATING SUPPLY AND RETURN PIPING, VALVES, FITTINGS, INSULATION AND HANGERS ARE TO BE REMOVED AND TAKEN OFF SITE AND BECOME PROPERTY OF THE CONTRACTOR UNLESS NOTED OTHERWISE. PIPING THAT IS TO BE ABANDONED IN PLACE SHALL BE CUT AND CAPPED BELOW FLOOR OR WITHIN TRENCH, AND THE OPENING SEALED WITH CONCRETE.
4. PROVIDE TEMPORARY COVERS AND CAPS FOR TEMPORARILY EXPOSED EXISTING PIPING, EQUIPMENT AND WALL OPENINGS. TEMPORARY COVERS AND CAPS SHALL BE SUFFICIENT TO ENSURE DIRT, WEATHER AND CONSTRUCTION DEBRIS WILL NOT ENTER ANY SYSTEM OR WALL, ROOF OR FLOOR OPENING.
5. REMOVAL AND DISPOSAL OF GAS PIPING AND GAS FIRED APPLIANCES SHALL BE IN CONFORMANCE WITH NFPA 54.
6. EXISTING GAS PIPING SHALL FIRST BE DISCONNECTED FROM ALL SOURCES OF GAS AND THEN THOROUGHLY PURGED WITH AIR, WATER, OR INERT GAS BEFORE CUTTING OR WELDING IS DONE.
7. WHEN GAS PIPING IS OPENED, THE SECTION TO BE WORKED ON SHALL BE TURNED OFF FROM THE GAS SUPPLY AT THE NEAREST CONVENIENT POINT, AND THE LINE PRESSURE VENTED TO THE OUTDOORS, OR TO VENTILATED AREAS OF SUFFICIENT SIZE TO PREVENT ACCUMULATION OF FLAMMABLE MIXTURES. IF THIS SECTION EXCEEDS 50 FEET OF 2.5" PIPING, THE REMAINING GAS PIPING SHALL BE DISPLACED WITH AN INERT GAS.
8. SEE ELECTRICAL PLANS FOR INFORMATION ON WIRING TERMINATION OF DEMO'D EQUIPMENT.
9. REFER TO ARCHITECTURAL DRAWINGS FOR CEILING DEMOLITION PLAN.
10. PATCHING AND PAINTING AT UNIT VENTILATOR, FIN TUBE, UNIT HEATER, AND THERMOSTAT LOCATIONS BY GENERAL TRADES. SEE ARCHITECTURAL DRAWINGS FOR FINISH SCHEDULE.
11. THE CONTRACTOR SHALL PROVIDE PROTECTION FOR ALL ROOFTOP AND WALL OPENINGS CREATED BY DEMOLITION SUITABLE FOR WITHSTANDING WEATHER CONDITIONS.
12. ALL ASBESTOS CONTAINING MATERIALS WILL BE REMOVED BY OTHERS PRIOR TO DEMOLITION.
13. THE INFORMATION SHOWN ON THESE DRAWINGS WAS COMPILED FROM EXISTING DRAWINGS AND SITE VISITS. HOWEVER, THE INFORMATION MAY STILL VARY FROM THE ACTUAL INSTALLATION. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION FOR DEMOLITION WORK.

- B — BOILER
- P — PUMP
- DUCTWORK
- RHC — RE-HEAT COIL
- HYDRONIC SUPPLY AND RETURN PIPING
- PIPING ELBOW DOWN
- PIPING ELBOW UP
- DEMOLISH MECHANICAL EQUIPMENT IN HATCHED AREA, INCLUDING ALL RELATED PIPING, INSULATION, VALVES, FITTINGS, DUCTWORK, INSULATION, HANGERS, SUPPORTS, HARDWARE, DEVICES AND INSULATION, ENCLOSURES, MOUNTS, AND WALL LOUVERS UNLESS OTHERWISE NOTED.



1 / M-000 HOSE BIBS DETAIL
SCALE: NTS

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SIGNATURE: _____
DATE OF SIGNATURE: _____
DATE OF REGISTRATION EXPIRATION: _____

ARCHITECT / ENGINEER SEAL

PROJECT

RETHINKING POWER MANAGEMENT
HVAC UPGRADES
AT THE
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

REVISIONS

MARK	DESCRIPTION	DATE
-	-	-

SHEET TITLE

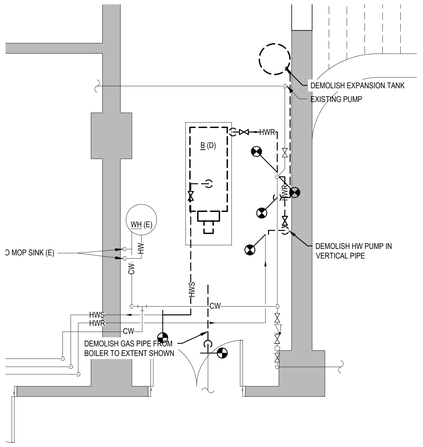
MECHANICAL COVER SHEET

OWNER REVIEW
9/9/2021

DRAWN	CHK'D	PROJECT NO.
TMC	BMZ	21073

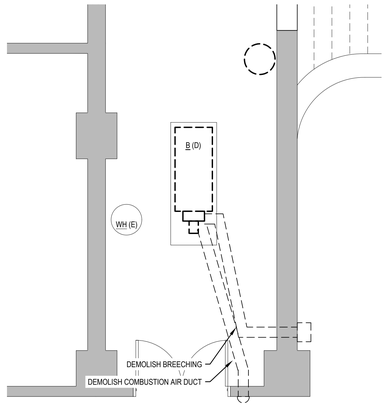
SHEET NO.

M-000



1 M-101 BOILER RM. PIPING DEMO PLAN

SCALE: 1/4" = 1'-0"



2 M-101 BOILER RM. MECH DEMO PLAN

SCALE: 1/4" = 1'-0"

INFRARED RADIANT HEATER SCHEDULE

IRH - #

UNIT NUMBER	KW	ELEMENTS IN ENCLOSURE	ELEMENT TYPE	ELEC	MANUFACTURER	MODEL #	REMARKS
IRH-1	2	2	QUARTZ TUBE	277/1/60	QMARK	FRP2-26S-2QT-10-208	(QTY 13) INCLUDE STEEL WIRE GUARDS

NOTE: PROVIDE UNITS AS SCHEDULED OR APPROVED EQUAL. MOUNT AT 10' A.F.F. PROVIDE WITH TWO-STAGE TEMPERATURE CONTROL AND WALL THERMOSTAT. LOCATE WALL THERMOSTAT SO THAT THERMOSTAT IS NOT DIRECTLY IN RADIANT PATH. PROVIDE WITH 60 DEGREE SYMMETRICAL REFLECTIVE PATTERN. INSTALL PER MANUFACTURER'S INSTRUCTIONS

RETURN GRILLE SCHEDULE

R - #

UNIT NUMBER	SIZE (FACE / NECK)	DESCRIPTION	MANUFACTURER	MODEL NUMBER	REMARKS
R-1	18"X12"	ALUMINUM RETURN GRILLE	KRUEGER	S580	

NOTE: PROVIDE EQUIPMENT BY KRUEGER OR APPROVED EQUAL. FINISH SHALL BE FACTORY OFF-WHITE FINISH. CONTRACTOR IS RESPONSIBLE TO SELECT APPROPRIATE MOUNT DEPENDING ON CEILING TYPE.

ELECTRIC DUCT HEATER SCHEDULE

UNIT NUMBER	AIRFLOW (CFM)	HEATING EAT/LAT(°F)	DUCT DIMENSIONS	AIRFLOW ORIENTATION	ELECTRICAL	ELECTRICAL POWER (KW)	MANUFACTURER	MODEL	REMARKS
DHC-1	650	52/72	18"X10"	Horizontal	277/1	4.1	RENEWAIRE	EK	

NOTE: PROVIDE UNITS IN NEMA 1 ENCLOSURE, WITH MANUAL RESET HI-LIMIT SWITCHES, MAGNETIC CONTACTORS, 24V CONTROL TRANSFORMERS, AIRFLOW SWITCH FOR POSITIVE PRESSURE, DISCONNECT SWITCH W/ INTERLOCKING COVER AND SCR CONTROL WITH 0-10VDC INPUT SIGNAL. CONTRACTOR TO MAINTAIN 36" CLEARANCE TO DISCONNECT PER NEC. PROVIDE DUCT TEMPERATURE SENSOR FOR LAT CONTROL.

INDIRECT FIRED HW GENERATOR SCHEDULE

HX - #

UNIT NUMBER	RECOVERY RATE (GPH)	CAPACITY (GAL)	TUBE BUNDLE			TANK		MFGR	MODEL #	REMARKS
			EWT (°F)	LWT (°F)	PD (FT-H2O)	EWT (°F)	LWT (°F)			
HX-1	400	200	160	120	X	50	140	PRECISION	PHWS-V3070PS-400-W160	

NOTE: PROVIDE UNITS AS SCHEDULED OR APPROVED EQUAL. PROVIDE WITH ENTERING BOILER WATER TEMP GAUGE AND LEAVING BOILER WATER TEMP GAUGE. TANK SHALL BE FACTORY INSULATED & JACKETED (MIN 2" HEAVY DUTY FIBERGLASS INSULATION W/ 16 GAUGE PAINTED STEEL JACKET). PROVIDE WITH THREE WAY DIVERTING CONTROL VALVE TO MAINTAIN TANK TEMPERATURE AS SCHEDULED. SEE PIPING SCHEMATIC

CONDENSING BOILER SCHEDULE

B-X

UNIT NUMBER	LOCATION	BOILER										REMARKS
		CAPACITY INPUT MBH	CAPACITY OUTPUT MBH	HW FLOW (GPM)	W.P.D. (FT-H20)	E.W.T. (°F)	L.W.T. (°F)	ELECTRICAL	TOTAL AMPS	WEIGHT (LBS)	MANUFACTURER/ MODEL #	
B-1	BOILER ROOM	399	376	25.1	12.5	110	140	120/1/60	1.83	340	RBI IB-399	

NOTES: PROVIDE ALL UNITS AS SCHEDULED OR APPROVED EQUAL. PROVIDE ALL UNITS WITH INTEGRAL GAS TRAIN, OPERATING THERMOSTAT WITH MANUAL RESET, CONDENSATE NEUTRALIZATION KIT AND HIGH-LIMIT THERMOSTAT, HIGH EXHAUST PRESSURE SWITCH, LWCO (PROBE TYPE WITH MANUAL RESET), AIR SWITCH (DIFFERENTIAL PRESSURE TYPE), AND VARIABLE SPEED COMBUSTION BLOWER.

ENERGY RECOVERY VENTILATOR SCHEDULE

ERV - #

UNIT NUMBER	SUPPLY AIRFLOW (CFM)	EXHAUST AIRFLOW (CFM)	SUMMER			WINTER			SUPPLY E.S.P. (IN-W.G.)	EXHAUST E.S.P. (IN-W.G.)	ELEC	MOTOR QTY	MOTOR HP	MCA	MOCP	MANUFACTURER	MODEL	REMARKS
			SUPPLY E.D.B./E.W.B. (°F)	SUPPLY L.D.B./L.W.B. (°F)	EXHAUST E.D.B./E.W.B. (°F)	SUPPLY E.D.B./E.W.B. (°F)	SUPPLY L.D.B./L.W.B. (°F)	EXHAUST E.D.B./E.W.B. (°F)										
ERV-1	650	650	89.7/73.2	79.0/67.9	75/62.6	6.1/3.0	52.7/41.7	70/54.4	0.25	0.025	208/3/60	2	0.5	10.8	15	RENEWAIRE	HE1XINH	

NOTE: PROVIDE UNITS AS SCHEDULED OR APPROVED EQUAL. PROVIDE W/ EC MOTORS ON SUPPLY AND EXHAUST FANS WITH SINGLE POINT POWER CONNECTION. ALL UNITS SHALL BE PROVIDED WITH HANGING SPRING ISOLATORS. EXHAUST AIR CONDITIONS ARE 75 DEG. F DB @ 50% RH IN COOLING MODE AND 70 DEG. F DB @ 35% RH IN HEATING MODE. PROVIDE MERV-8 FILTERS ON BOTH AIR STREAMS. PROVIDE MFGR'S TIME CLOCK FOR OCCUPIED/UNOCCUPIED CONTROL. PROVIDE WITH MFGR'S PRE-WIRED, FIELD INSTALLED MOTORIZED ISOLATION DAMPERS FOR BOTH AIRSTREAMS.

ELECTRIC UNIT HEATER SCHEDULE

UH - #

UNIT NUMBER	KW	CFM	ELEC	MFG MODEL #	REMARKS
UH-1	5	350	277/1/60	QMARK MUH0571	

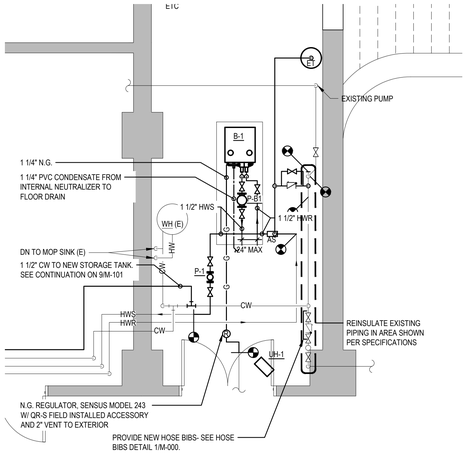
NOTE: PROVIDE UNITS AS SCHEDULED OR APPROVED EQUAL. PROVIDE WITH MOUNTING BRACKET, INTEGRAL THERMOSTAT, DISCONNECT AND LOUVERED DIFFUSER

PUMP SCHEDULE

P - #

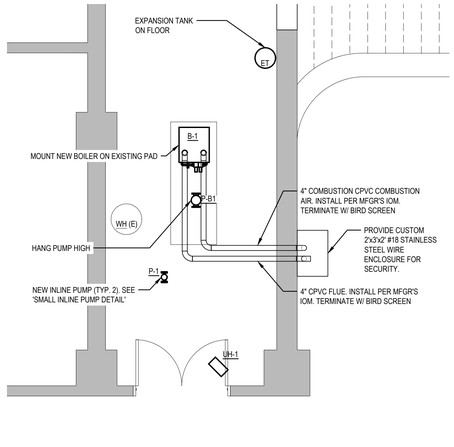
UNIT NUMBER	UNIT TYPE	MAKE	MODEL #	RPM	GPM	TDH (FT)	HP	ELEC	REMARKS
P-1	INLINE CENTRIFUGAL PUMP	BELL & GOSSETT	ECOCIRC XL 36-45	3300	25	20	1/6	115/1/60	SYSTEM CIRCULATOR. EC MOTOR
P-B1	INLINE CENTRIFUGAL PUMP	BELL & GOSSETT	E-90	1800	25.1	16	1/3	115/1/60	BOILER CIRCULATOR

NOTES: PROVIDE EQUIPMENT AS SCHEDULED OR APPROVED EQUAL.



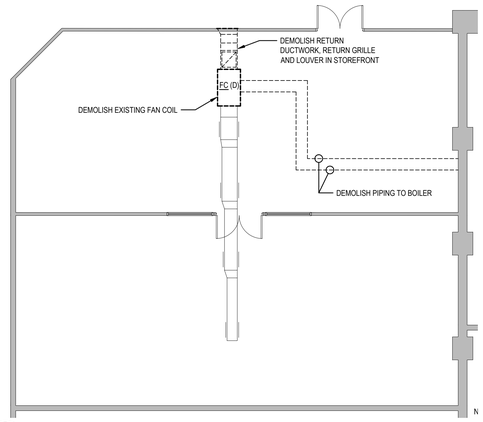
3 M-101 BOILER RM. PIPING NEW PLAN

SCALE: 1/4" = 1'-0"



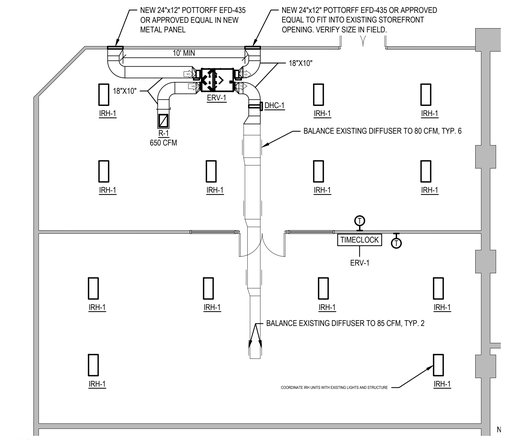
4 M-101 BOILER RM. MECH NEW WORK PLAN

SCALE: 1/4" = 1'-0"



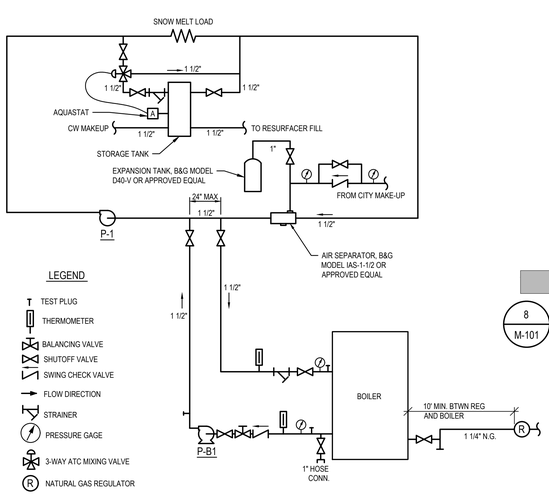
5 M-101 SKATE SHOP MECHANICAL DEMOLITION PLAN

SCALE: 1/8" = 1'-0"



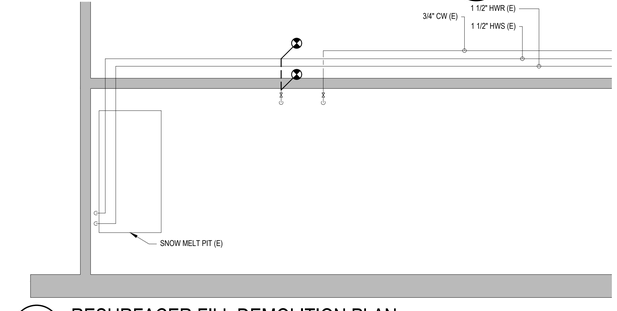
6 M-101 SKATE SHOP MECHANICAL NEW WORK PLAN

SCALE: 1/8" = 1'-0"



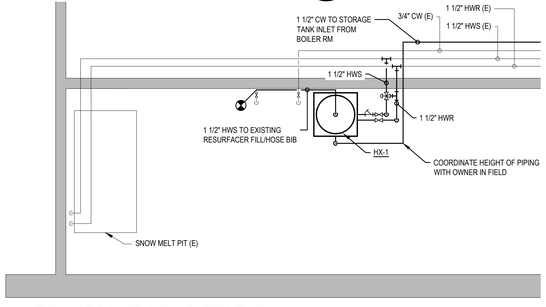
7 M-101 PIPING SCHEMATIC

SCALE: NTS



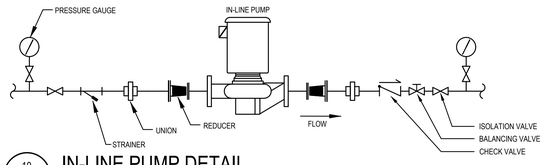
8 M-101 RESURFACER FILL DEMOLITION PLAN

SCALE: 1/4" = 1'-0"



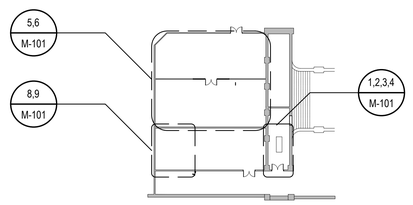
9 M-101 RESURFACER FILL NEW PLAN

SCALE: 1/4" = 1'-0"



10 M-101 IN-LINE PUMP DETAIL

SCALE: NTS



KEY PLAN

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SIGNATURE: ______________________
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ARCHITECT / ENGINEER SEAL

PROJECT

RETHINKING POWER MANAGEMENT
HVAC UPGRADES
AT THE
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

REVISIONS

MARK	DESCRIPTION	DATE
-	-	-

SHEET TITLE

MECHANICAL PLANS

OWNER
REVIEW
9/9/2021

DRAWN	CHK'D	PROJECT NO.
TMC	BMZ	21073

SHEET NO.

M-101

9/9/2021 3:12 PM

ELECTRICAL GENERAL NOTES

1. PROVIDE ALL LABOR, MATERIALS, TOOLS, EQUIPMENT, COORDINATION, ADDITIONAL DESIGN AND ALL INCIDENTALS NECESSARY TO PROVIDE A COMPLETE AND OPERABLE SYSTEM AS DETAILED ON PLANS TO THE SATISFACTION OF THE ENGINEER AND THE OWNER. COORDINATE ALL WORK WITH THE ENGINEER BEFORE THE START OF WORK.
2. PRIOR TO SUBMITTING BID, THE CONTRACTOR SHALL VISIT THE SITE AND BE THOROUGHLY FAMILIAR WITH THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION. CONTRACTOR SHALL INCLUDE IN THEIR BID ALL MATERIAL, LABOR, AND ALL INCIDENTALS FOR A COMPLETE INSTALLATION WHETHER SPECIFICALLY INDICATED OR NOT. ALL ERRORS, DISCREPANCIES AND MISSED ITEMS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER DURING THE BIDDING PROCESS BY THE CONTRACTOR. THESE ITEMS SHALL BE INCLUDED IN THE BID PRICE. NO EXTRA COST WILL BE ALLOWED FOR ANY DISCREPANCY WHICH COULD HAVE BEEN NOTICED AT THE SITE VISIT BY THE CONTRACTOR.
3. PERFORM WORK AS REQUIRED BY APPLICABLE CODES, REGULATIONS, AND LAWS OF LOCAL, STATE, AND FEDERAL GOVERNMENTS AND OTHER AUTHORITIES WITH LAWFUL JURISDICTION. ALL WORK SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE.
4. MATERIAL AND EQUIPMENT SHALL BE NEW (UNLESS NOTED), UL, NEMA, ANSI, IEEE, ADA & CMB APPROVED FOR INTENDED PURPOSE. MATERIAL AND INSTALLATION SHALL MEET REQUIREMENTS OF NATIONAL AND LOCAL ELECTRICAL CODE.
5. GIVE NOTICES, FILE PLANS, OBTAIN PERMITS, AND LICENSES, PAY FEES AND BACK CHARGES, AND OBTAIN NECESSARY APPROVALS FROM AUTHORITIES THAT HAVE JURISDICTION.
6. MAINTAIN RECORD DRAWINGS ON SITE. RECORD SET MUST BE COMPLETE AND CURRENT AND AVAILABLE FOR INSPECTION WHEN REQUISITIONS FOR PAYMENT ARE SUBMITTED.
7. GUARANTEE WORK IN WRITING PER SPECIFICATIONS, REPAIR OR REPLACE DEFECTIVE MATERIALS OR INSTALLATION AT NO COST TO OWNER DURING THE GUARANTEE PERIOD. CORRECT DAMAGE CAUSED IN MAKING NECESSARY REPAIRS AND REPLACEMENTS UNDER GUARANTEE AT NO COST TO OWNER. SUBMIT GUARANTEE TO OWNER BEFORE FINAL PAYMENT.
8. COORDINATE ALL ELECTRICAL ITEMS WITH EXISTING FIELD CONDITIONS. LOCATIONS SHOWN ARE APPROXIMATE AND MAY REQUIRE MINOR ADJUSTMENT IN THE FIELD TO SATISFY THE DESIGN INTENT.
9. DAMAGE TO EXISTING FACILITIES AND EQUIPMENT SHALL BE REPAIRED OR REPLACED IMMEDIATELY BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
10. THE LOCATIONS ON THESE PLANS ARE APPROXIMATE AND REQUIRE COORDINATION WITH ALL OTHER TRADES AND VERIFICATION OF EXISTING CONDITIONS. ROUTING OF CONDUIT IS DIAGRAMMATIC IN NATURE AND NOT INTENDED TO SHOW ALL REQUIRED OFFSETS AND DETAILS. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF ALL EXISTING ASSOCIATED EQUIPMENT AND CONDITIONS. COORDINATE THE LOCATION OF ALL EQUIPMENT WITH THE ENGINEER AND THE OWNER. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL OTHER TRADE'S DRAWINGS AND SPECIFICATIONS AND COORDINATING WITH ALL OTHER TRADES DURING BIDDING AND CONSTRUCTION. THE CONTRACTOR IS TO INCLUDE CIRCUIT LENGTHS OF WIRE AND CONDUIT REQUIRED TO INSTALL CONNECTED DEVICES AND EQUIPMENT SUCH AS PANELBOARDS, SWITCHBOARDS, TRANSFORMERS, ETC. WITHIN 15 FEET OF THE LOCATION SHOWN.
11. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING CONTINUITY OF ALL POWER, CONTROL, FIRE ALARM, SECURITY SYSTEMS, AND COMMUNICATIONS FUNCTIONS TO ALL AREAS AFFECTED BY DEMOLITION AND/OR NEW CONSTRUCTION.
12. REPAIR AND PATCH ANY DISTURBED AREAS TO MATCH ADJACENT CONSTRUCTION.
13. DISCONNECT AND MAKE SAFE ANY EQUIPMENT TO BE REMOVED BY OTHERS. COORDINATE REMOVAL OF EQUIPMENT WITH OTHER TRADES PRIOR TO DEMOLITION.
14. IN ANY AREA REQUIRING THE PERFORMANCE OF ANY TRADE'S WORK, THIS CONTRACTOR SHALL CAREFULLY REMOVE AND STORE ANY OR ALL ELECTRICAL ITEMS IN PATH OF WORK, REINSTALLING, AND RECONNECTING SAME AS REQUIRED, IN ACCORDANCE WITH THE PLANS AND/OR AS DIRECTED AFTER COMPLETION OF OTHER TRADE'S WORK IN THAT AREA.
15. PRIOR TO THE START OF DEMOLITION, CONTRACTOR SHALL FIELD VERIFY ALL BRANCH CIRCUITS AND MAINTAIN THOSE CIRCUITS THAT EXTEND OUTSIDE THE SCOPE OF WORK.
16. AFTER RENOVATING EXISTING ELECTRICAL WORK, THE CONTRACTOR SHALL ENSURE THAT ALL REMAINING AND NEW EQUIPMENT WILL OPERATE PROPERLY, INCLUDING BUT NOT LIMITED TO BACKFEEDING OF EXISTING POWER AND LIGHTING CIRCUITS. REFER TO SINGLE LINE DIAGRAM.
17. ALL ELECTRICAL WORK INDICATED TO REMAIN SHALL BE SUITABLY PROTECTED TO PREVENT ANY DAMAGE.
18. WHERE ELECTRICAL SYSTEMS PASS THROUGH RENOVATED AREAS TO SERVE OTHER PORTIONS OF THE PREMISES, SYSTEMS SHALL BE SUITABLY PROTECTED TO PREVENT DAMAGE OR RELOCATED AND THE SYSTEMS RESTORED TO NORMAL OPERATION. ANY OUTAGES IN SYSTEMS SHALL BE COORDINATED WITH OWNER. RESTORE POWER TO EXISTING TO REMAIN EQUIPMENT IF INTERRUPTED BY DEMOLISHED CIRCUITS IN THE AREA.
19. CONTRACTOR SHALL SUBMIT FOR REVIEW, SHOP DRAWINGS FOR ALL EQUIPMENT AND MATERIALS USED ON THE PROJECT. SUBMITTALS SHALL BE REVIEWED BY THE ENGINEER BEFORE PURCHASE OF MATERIALS.
20. ALL WIRING SHALL BE COPPER, 600V, 75°/90° RATED WITH FLAME-RETARDENT, HEAT AND MOISTURE RESISTANT INSULATION.
21. PERMANENTLY LABEL ALL NEW ELECTRICAL EQUIPMENT, INCLUDING BUT NOT LIMITED TO, DEVICE DESIGNATION AND SUPPLY CIRCUIT DESIGNATION. UPDATE OR REPLACE PANEL DIRECTORIES TO INCLUDE NEW CIRCUIT INFORMATION RESULTING FROM THIS PROJECT.
22. PROVIDE TEMPORARY POWER AND LIGHTING FOR ALL TRADES AS REQUIRED TO COMPLETE THE PROJECT. ALL TEMPORARY AND INTERIM EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE CODES AND STANDARDS INCLUDING, BUT NOT LIMITED TO NFPA 110 AND NFPA 70.
23. REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION THAT IS NOT SHOWN ON THE DRAWINGS.
24. OPENINGS IN EXISTING CONCRETE AND MASONRY WALLS AND FLOORS REQUIRED FOR CONDUIT INSTALLATION SHALL BE CORE DRILLED. MAXIMUM CORE DRILL SIZE SHALL BE 5" IN DIAMETER. CORE DRILL LOCATIONS SHALL BE SPACED A MINIMUM OF 6" FROM EACH OTHER MEASURED FROM THE OUTSIDE EDGE OF THE CORE DRILL. ALL CORE DRILL OPENINGS SHALL BE PROPERLY SEALED ACCORDING TO THEIR LOCATION AND APPLICATION.
25. ALL OUTAGES SHALL BE KEPT TO A MINIMUM. ALL WORK THAT REQUIRES A SUSTAINED EQUIPMENT OUTAGE SHALL BE PERFORMED CONTINUOUSLY AROUND THE CLOCK UNTIL WORK IS COMPLETED UNLESS NOTED OTHERWISE. COORDINATE OUTAGES WITH OWNER REPRESENTATIVE.
26. PROVIDE FOR EACH BRANCH CIRCUIT AND FEEDER CIRCUIT A DEDICATED EQUIPMENT GROUND WIRE. FOR SINGLE PHASE BRANCH CIRCUITS OF 120 V/1PH OR 277V/1 PH, PROVIDE DEDICATED HOT, DEDICATED NEUTRAL AND DEDICATED EQUIPMENT GROUND WIRES. SHARING OF NEUTRAL OR EQUIPMENT GROUND WIRES IS NOT PERMITTED. WIRING TO ALL HVAC EQUIPMENT OR OTHER TRADE EQUIPMENT SHALL BE IN CONDUIT. ALL EQUIPMENT AND FEEDER WIRING IN MECHANICAL ROOM/ELECTRICAL ROOM SHALL BE IN RIGID CONDUIT. USE OF MC CABLE IS LIMITED TO BRANCH CIRCUIT WIRING ABOVE RECESSED CEILING OR CONCEALED IN WALL. DO NOT USE PLASTIC TIE WRAPS TO SUPPORT CONDUITS AND MC CABLES. MC CABLES SHALL BE SUPPORTED AT MAXIMUM OF 6'-0" WITH SECURELY FASTENED MC CABLE SUPPORT CLAMPS, J-HOOKS, OR METAL CABLE BRACKETS.
27. PROVIDE IDENTIFICATION LABELS FOR ALL BRANCH CIRCUITS AND FEEDERS CIRCUITS AT JUNCTION BOXES, PANELBOARDS, TROUGHS, AND SPLICE BOXES.
28. PROVIDE UNSPLICED FEEDERS FROM PANELBOARD OR SWITCHBOARD TO ALL EQUIPMENT, INCLUDING ALL 20 AMPERE, SINGLE POLE BRANCH CIRCUIT WIRING.
29. ALL WIRING DEVICES ARE TO BE RECESSED WHERE POSSIBLE. WHERE RECESSING IS NOT POSSIBLE, WIRING DEVICES ARE TO BE SURFACE MOUNTED WITH CIRCUIT WIRING ROUTED IN SURFACE MOUNTED CONDUIT PER SPECIFICATIONS.
30. ALL CONDUIT PENETRATIONS THROUGH WALLS OR CEILINGS SHALL BE PATCHED AND SEALED WITH FIRE RATED FOAM SEALANT.
31. PROVIDE INSULATING BUSHINGS ON CONDUIT THREADS OR CONNECTORS WHERE RACEWAYS WITH CONDUITS OR MC CABLES ENTER A BOX OR ENCLOSURE. THIS BUSHING SHALL BE INSTALLED ON ALL CABLES AND CONDUITS.
32. CONTRACTOR TO PROVIDE A COORDINATION STUDY WHENEVER ANY FEEDER CIRCUITS ARE ADDED TO OR REMOVED FROM THE MAIN SWITCHBOARD / PANELBOARD OF A BUILDING. ADDITIONALLY, PROVIDE A COORDINATION STUDY WHENEVER A GENERATOR IS ADDED OR REPLACED. CONTRACTOR TO ADJUST THE TRIP OF THE MAIN CIRCUIT BREAKER AND/OR THE GENERATOR BREAKER ACCORDINGLY.
33. (N) DENOTES NEW EQUIPMENT OR WIRING.
(E) DENOTES EXISTING EQUIPMENT OR WIRING TO REMAIN.
(D) DENOTES EQUIPMENT OR WIRING TO BE DEMOLISHED.

ELECTRICAL SYMBOL LEGEND

Power Devices

Symbol	Description
JB	JUNCTION BOX
SM	FRACTIONAL HORSEPOWER MOTOR STARTER WITH OVERLOAD IN NEMA 1 ENCLOSURE; SQ'D FG2P OR APPROVED EQUAL FOR INDOORS, FW2P FOR OUTDOORS WITH NEMA 4 ENCLOSURE
ESPB	EMERGENCY STOP PUSH BUTTON - SEE BOILER EMERGENCY SHUTOFF CONTROL DIAGRAM [ESPB] ON THIS SHEET
	FUSED DISCONNECT SWITCH-HEAVY DUTY, 3POLE WITH FUSE CLIPS SUITABLE FOR CLASS "R" FUSES. NEMA1 UNLESS NOTED. WP-WEATHER PROOF-NEMA3R ENCLOSURE. (NOMENCLATURE: 30A/20A = SWITCH SIZE/FUSE SIZE). SQ D CLASS 3110 OR EQUAL. DO NOT INSTALL ON TOP OF EQUIPMENT LABELS OR NAMEPLATES.

GRAPHIC CONVENTIONS

Wiring Devices

HOMERUN PANEL DESIGNATION → PLA-11 ← BRANCH CIRCUIT DESIGNATION

OUTLETS TO BE MOUNTED AT STANDARD HEIGHT UNLESS OTHERWISE NOTED

Disconnects

30A, WP / 20A, RK1

DISCONNECT SIZE, WP: WEATHER PROOF

FUSE SIZE, TYPE RK1

ELECTRICAL ABBREVIATIONS

(D) - DENOTES EQUIPMENT OR WIRING TO BE DEMOLISHED
(E) - DENOTES EXISTING EQUIPMENT OR WIRING TO REMAIN
(N) - DENOTES NEW EQUIPMENT OR WIRING

A - AMPS
AF - AMPERE FRAME
AFF - ABOVE FINISHED FLOOR
AT - AMPERE TRIP
ATS - AUTOMATIC TRANSFER SWITCH
BLDG - BUILDING
C - CONDUIT
CB - CIRCUIT BREAKER
ENCL - ENCLOSURE
FA - FIRE ALARM
G - GROUND
GE - GENERAL ELECTRIC
KA - KILO AMPERE
KV - KILO VOLT
KVA - KILO VOLT AMPERE
LG - LG CORPORATION
LI - LONG TIME + INSTANTANEOUS
LSI - LONG TIME + SHORT TIME + INSTANTANEOUS
MCB - MAIN CIRCUIT BREAKER
MDP - MAIN DISTRIBUTION PANEL
MTS - MANUAL TRANSFER SWITCH
MVASC - MEGA VOLT AMPERE SHORT CIRCUIT
OC - ON CENTER
PH - PHASE
QO - QWIK OPEN PROTECTION
SPD - SURGE PROTECTIVE DEVICE
SW - SWITCH
SWBD - SWITCHBOARD
UG - UNDERGROUND
V - VOLTS
W - WATTS OR WIRE
Z - IMPEDANCE

NEW PANEL

PANEL: PH1A
LOCATION: BOILER ROOM
BUS: 100A
MAIN: MLO
VOLTAGE: 480Y/277V, 3PH, 4W
ENCLOSURE: NEMA-1
A.I.C: 22,000
RATINGS: FULL

	ØA kVA	ØB kVA	ØC kVA	DESCRIPTION	Pole	Br	Ckt	Ckt	Br	Pole	DESCRIPTION	ØA kVA	ØB kVA	ØC kVA	
*	2.00	-	-	IRH-1	1	20	1	2	50	3	30KVA XFMR - PNL-PL1A	10	-	-	***
*	-	2.00	-	IRH-1	1	20	3	4				-	10	-	
*	-	-	2.00	IRH-1	1	20	5	6				-	-	10	
*	2.00	-	-	IRH-1	1	20	7	8	20	1	SPARE	-	-	-	****
*	-	2.00	-	IRH-1	1	20	9	10	20	1	SPARE	-	-	-	****
*	-	-	2.00	IRH-1	1	20	11	12	20	1	SPARE	-	-	-	****
*	2.00	-	-	IRH-1	1	20	13	14	-	-	SPACE	-	-	-	
*	-	2.00	-	IRH-1	1	20	15	16	-	-	SPACE	-	-	-	
*	-	-	2.00	IRH-1	1	20	17	18	-	-	SPACE	-	-	-	
*	2.00	-	-	IRH-1	1	20	19	20	-	-	SPACE	-	-	-	
*	-	2.00	-	IRH-1	1	20	21	22	-	-	SPACE	-	-	-	
*	-	-	2.00	IRH-1	1	20	23	24	-	-	SPACE	-	-	-	
*	2.00	-	-	IRH-1	1	20	25	26	-	-	SPACE	-	-	-	
**	-	4.10	-	DHC-1	1	20	27	28	-	-	SPACE	-	-	-	
**	-	-	5.00	UH-1	1	25	29	30	-	-	SPACE	-	-	-	

CONNECTED LOAD
PHASE A: 20 kVA
PHASE B: 22.1 kVA
PHASE C: 23 kVA
TOTAL CONNECTED LOAD = 65.1 kVA

* PROVIDE NEW CIRCUIT BREAKER AND NEW 2#12 + 1#12G - 3/4"C WIRING.
** PROVIDE NEW CIRCUIT BREAKER AND NEW 2#10 + 1#10G - 3/4"C WIRING.
*** PROVIDE NEW CIRCUIT BREAKER AND NEW WIRING. SEE SINGLE LINE DIAGRAM FOR WIRE AND CONDUIT SIZES.
**** PROVIDE NEW SPARE CIRCUIT BREAKER.

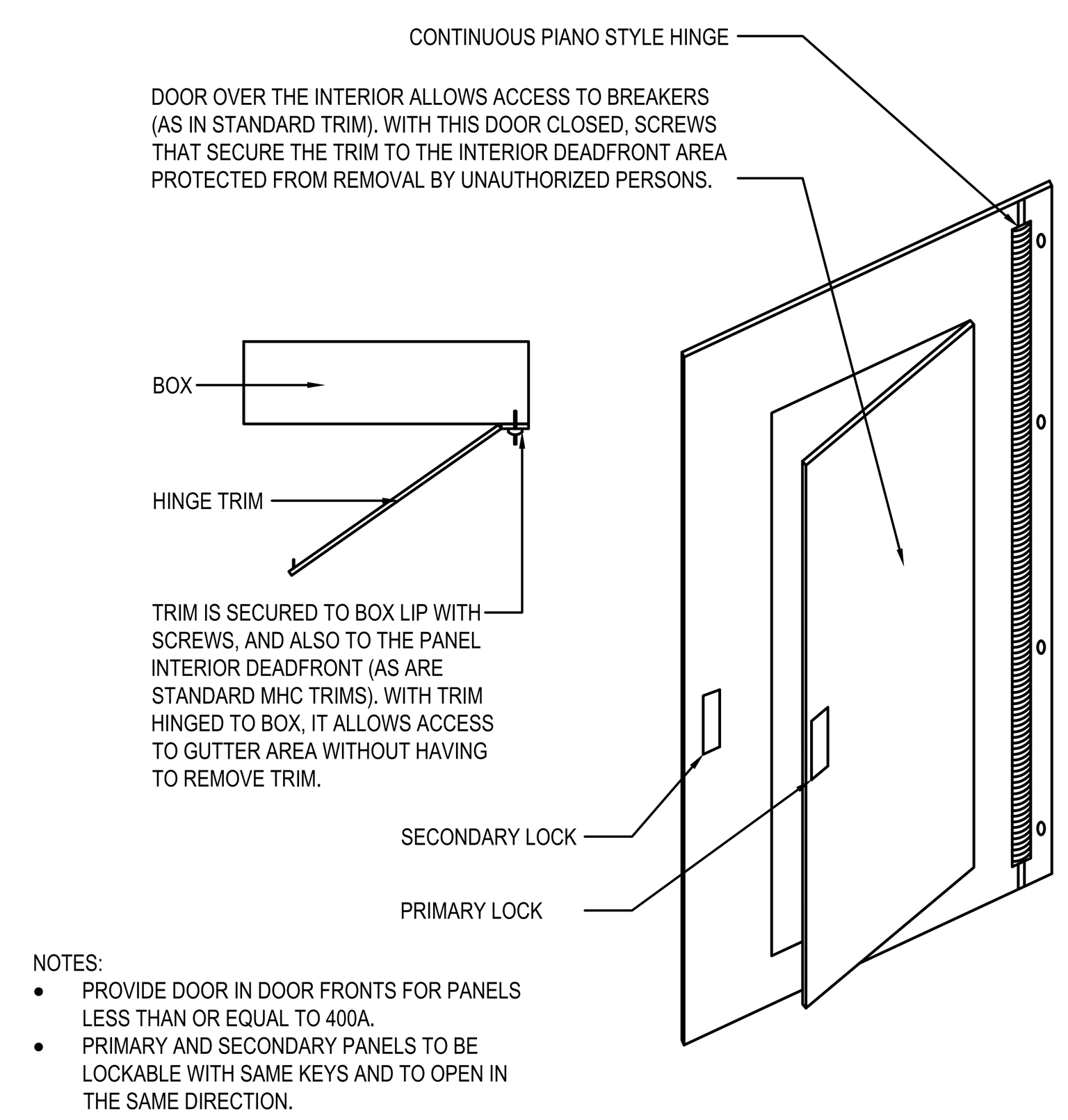
NEW PANEL

PANEL: PL1A
LOCATION: BOILER ROOM
BUS: 100A
MAIN: 100A MCB
VOLTAGE: 208Y/120V, 3PH, 4W
ENCLOSURE: NEMA-1
A.I.C: 14,000
RATINGS: FULL

	ØA kVA	ØB kVA	ØC kVA	DESCRIPTION	Pole	Br	Ckt	Ckt	Br	Pole	DESCRIPTION	ØA kVA	ØB kVA	ØC kVA	
*	0.53	-	-	P-1 - BOILER ROOM	1	20	1	2	20	1	BAS CONTROL PANEL	0.50	-	-	*
*	-	0.86	-	P-B1 - BOILER ROOM	1	20	3	4	20	1	BAS CONTROL PANEL	-	0.50	-	*
****	-	-	0.22	B-1 - BOILER ROOM (SHUNT TRIP)	1	20	5	6	20	1	SPARE	-	-	-	
	-	-	-				7	8	20	1	SPARE	-	-	-	
**	-	1.04	-	ERV-1	3	20	9	10	20	1	SPARE	-	-	-	
	-	-	1.04				11	12	20	1	SPARE	-	-	-	
	1.04	-	-				13	14	100	3	MCB	-	-	-	
	-	-	-	SPACE	-	-	15	16				-	-	-	
	-	-	-	SPACE	-	-	17	18				-	-	-	

CONNECTED LOAD
PHASE A: 2.07 kVA
PHASE B: 2.40 kVA
PHASE C: 1.26 kVA
TOTAL CONNECTED LOAD = 5.73 kVA

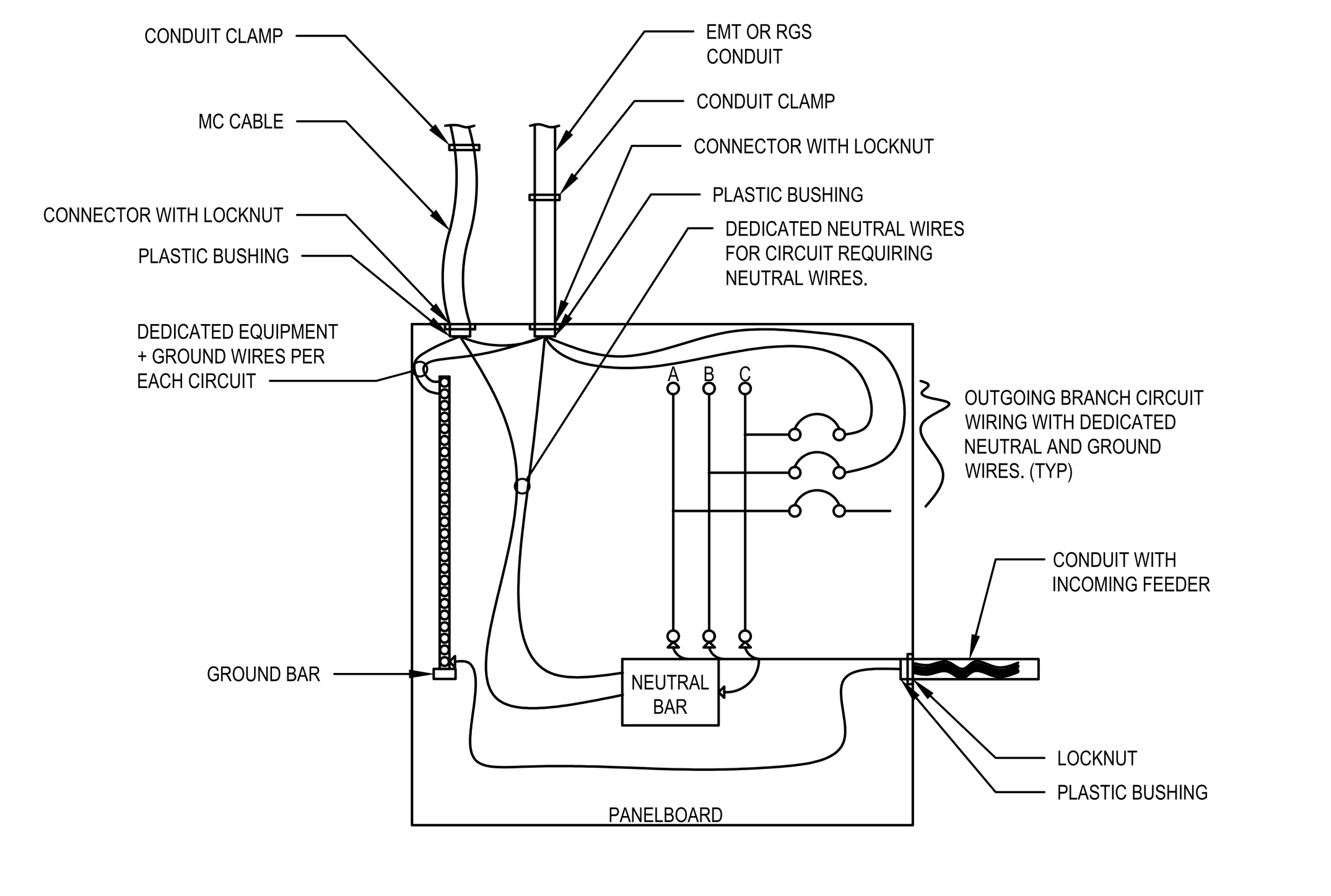
* PROVIDE NEW CIRCUIT BREAKER AND NEW 2#12 + 1#12G - 3/4"C WIRING.
** PROVIDE NEW CIRCUIT BREAKER AND NEW 3#12 + 1#12G - 3/4"C WIRING.
*** PROVIDE NEW SPARE CIRCUIT BREAKER.
**** PROVIDE NEW SHUNT TRIP CIRCUIT BREAKER AND NEW 2#12 + 1#12G - 3/4"C WIRING.



NOTES:
- PROVIDE DOOR IN DOOR FRONTS FOR PANELS LESS THAN OR EQUAL TO 400A.
- PRIMARY AND SECONDARY PANELS TO BE LOCKABLE WITH SAME KEYS AND TO OPEN IN THE SAME DIRECTION.

CUSTOM FULLY HINGED DOOR AND TRIM DETAIL

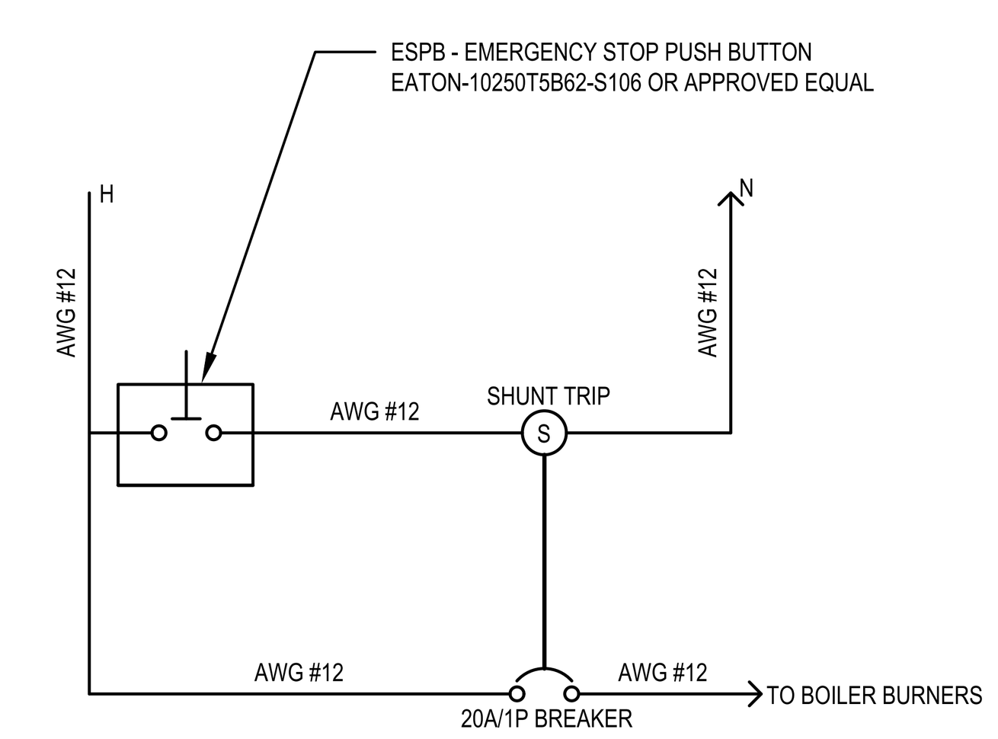
SCALE: NOT TO SCALE



NOTES:
1. PROVIDE GROUND BAR WITH ADEQUATE TERMINALS FOR EQUIPMENT GROUND WIRES.
2. DOUBLE LUGGING OF NEUTRAL OR EQUIPMENT GROUND WIRES IS NOT PERMITTED.
3. NUMBER OF NEUTRAL AND EQUIPMENT GROUND WIRES VARY BY PANEL AND BRANCH CIRCUITS.

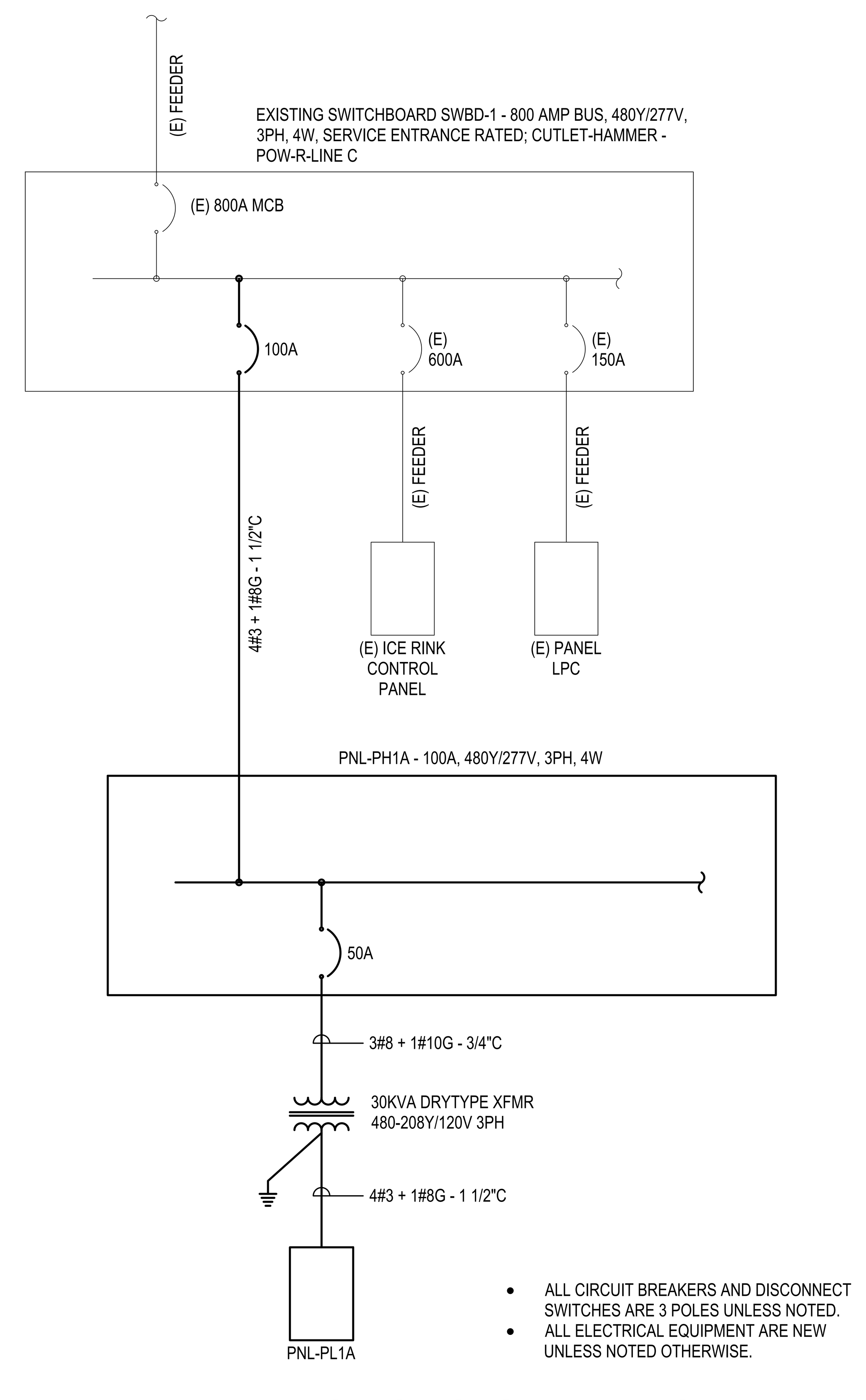
EQUIPMENT GROUND AND NEUTRAL WIRING IN PANELBOARD (TYP)

SCALE: NOT TO SCALE



BOILER EMERGENCY SHUTOFF CONTROL DIAGRAM [ESPB]

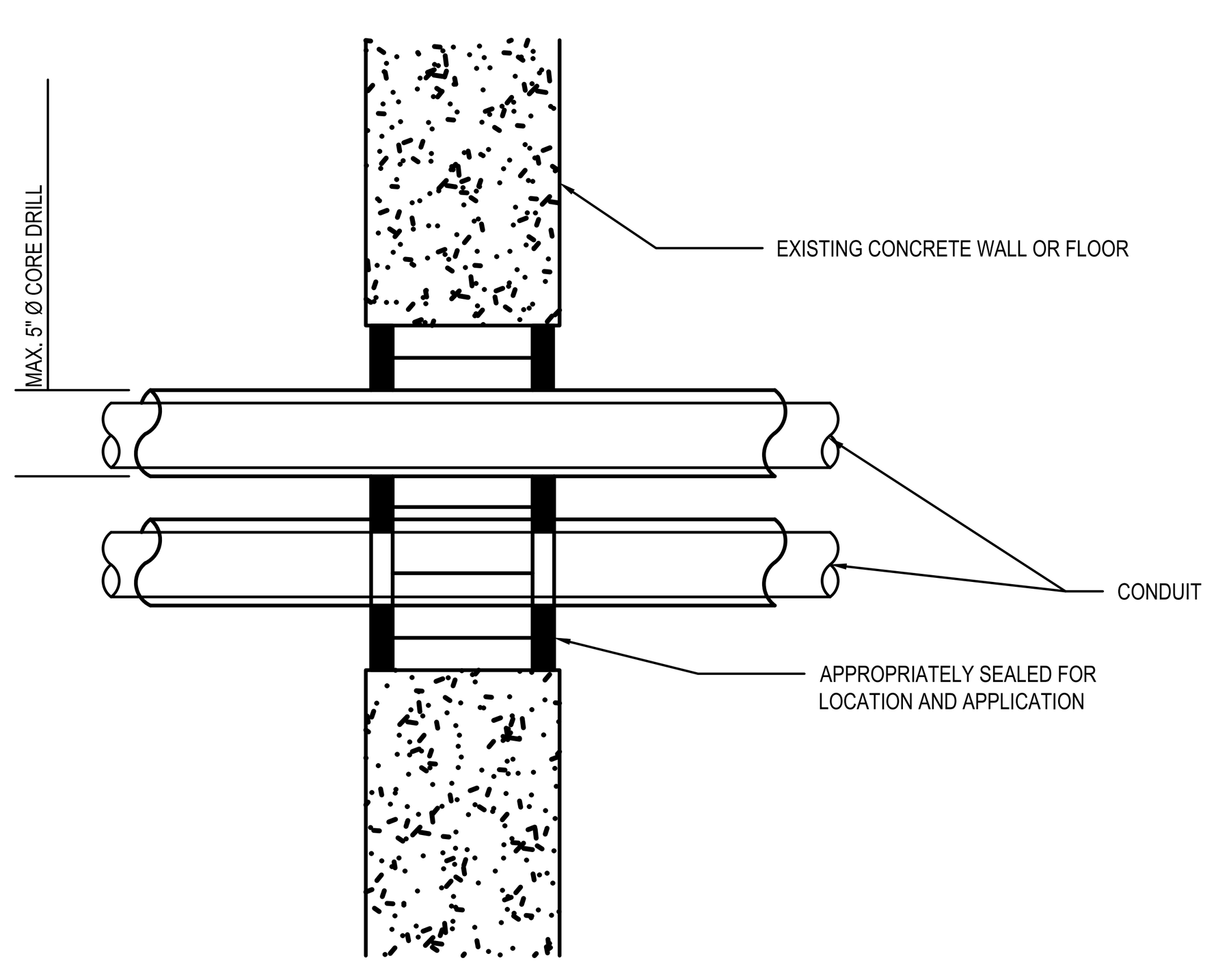
SCALE: NOT TO SCALE



- ALL CIRCUIT BREAKERS AND DISCONNECT SWITCHES ARE 3 POLES UNLESS NOTED.
- ALL ELECTRICAL EQUIPMENT ARE NEW UNLESS NOTED OTHERWISE.

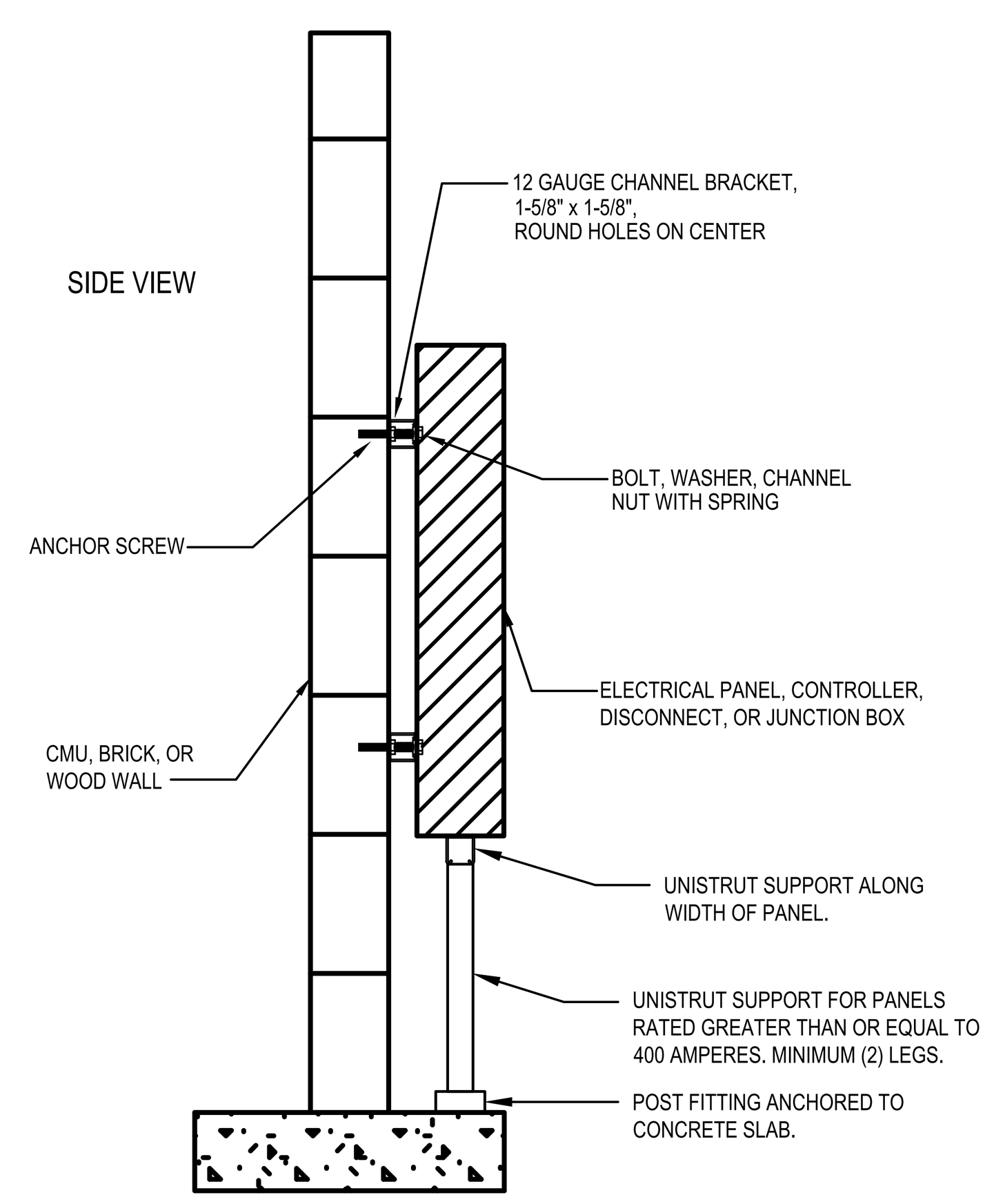
PARTIAL ELECTRICAL SINGLE LINE DIAGRAM

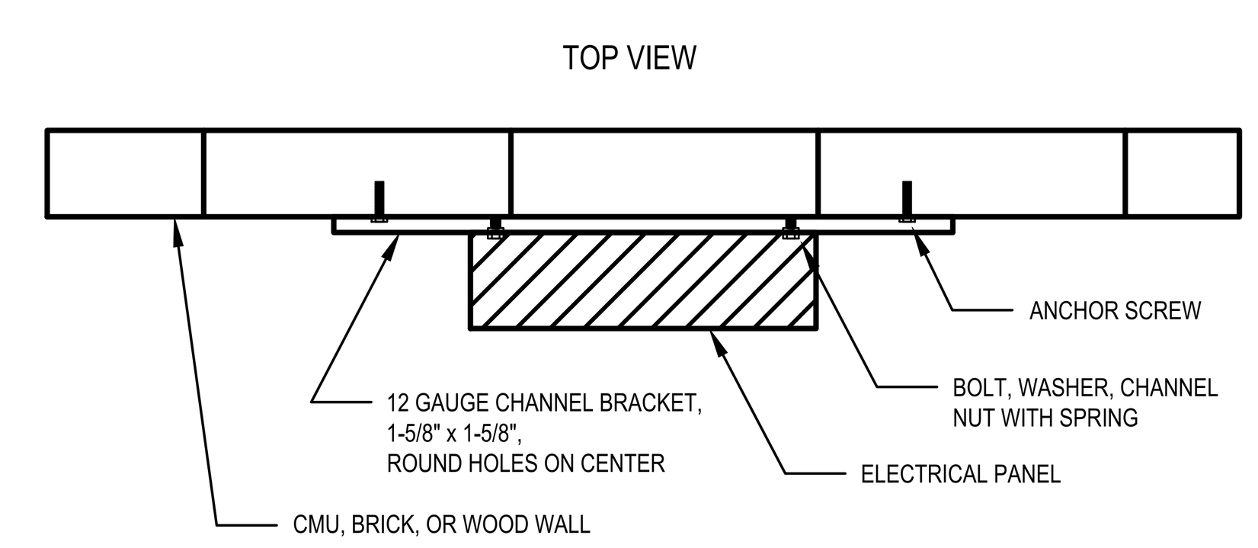
SCALE: NOT TO SCALE



TYPICAL PENETRATION IN WALL OR FLOOR

SCALE: NOT TO SCALE





TYPICAL ELECTRICAL PANEL MOUNT DETAIL

SCALE: NOT TO SCALE

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CRUMPTON, MARYLAND 216285

CONSULTANT

SIGNATURE: ______
DATE OF SIGNATURE: ______
DATE OF REGISTRATION EXPIRATION: ______

ARCHITECT / ENGINEER SEAL

PROJECT

RETHINKING POWER MANAGEMENT
HVAC UPGRADES
AT THE
CITY CENTER ICE RINK
2 KENNEDY PLAZA
PROVIDENCE, RI 02903

REVISIONS

MARK	DESCRIPTION	DATE
-	-	-

SHEET TITLE

ELECTRICAL COVER SHEET

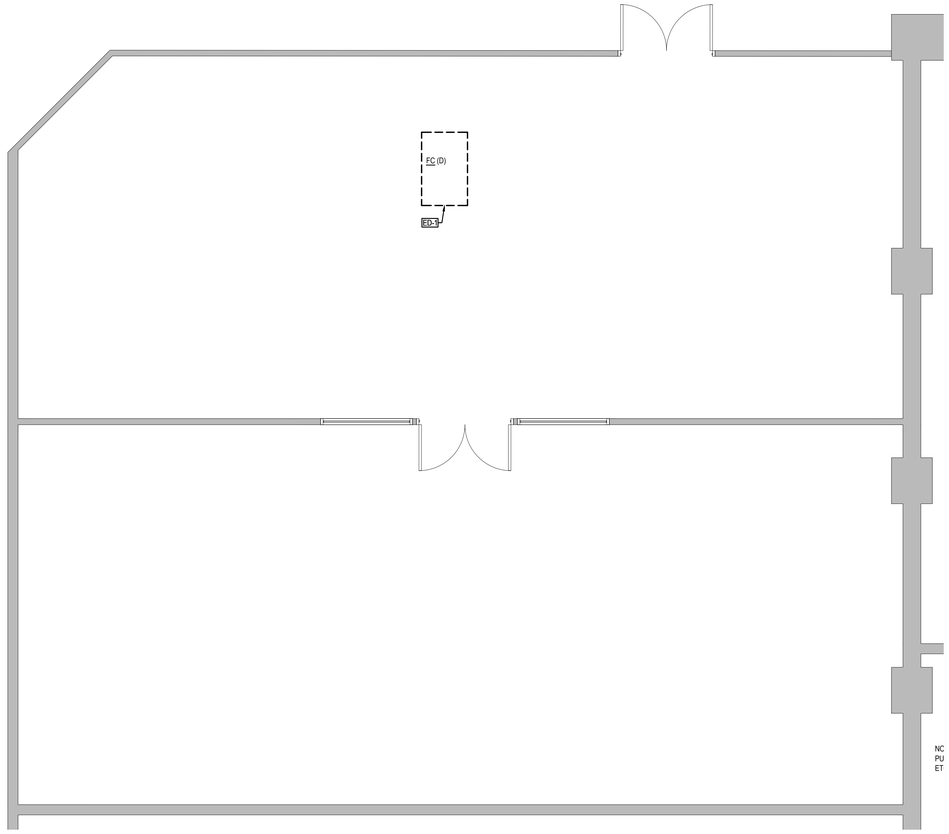
OWNER REVIEW
9/9/2021

DRAWN	CHK'D	PROJECT NO.
JD	PP	21073

SHEET NO.

E-000

9/9/2021 3:12 PM

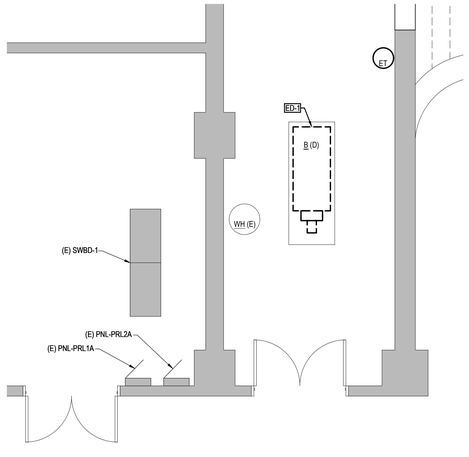


1 E-101 SCALE: 1/4" = 1'-0"

SKATE SHOP ELECTRICAL DEMOLITION PLAN

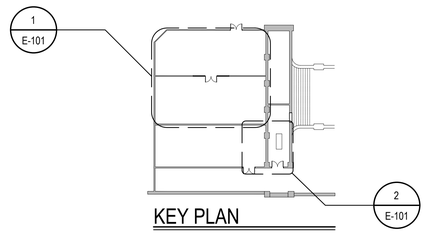
ELECTRICAL DEMOLITION NOTES:

ED-1 DISCONNECT AND REMOVE POWER FROM MECHANICAL UNIT INCLUDING BUT NOT LIMITED CONTROLLERS, STARTERS, DISCONNECT SWITCHES, WIRE, AND CONDUIT COMPLETELY BACK TO SOURCE.

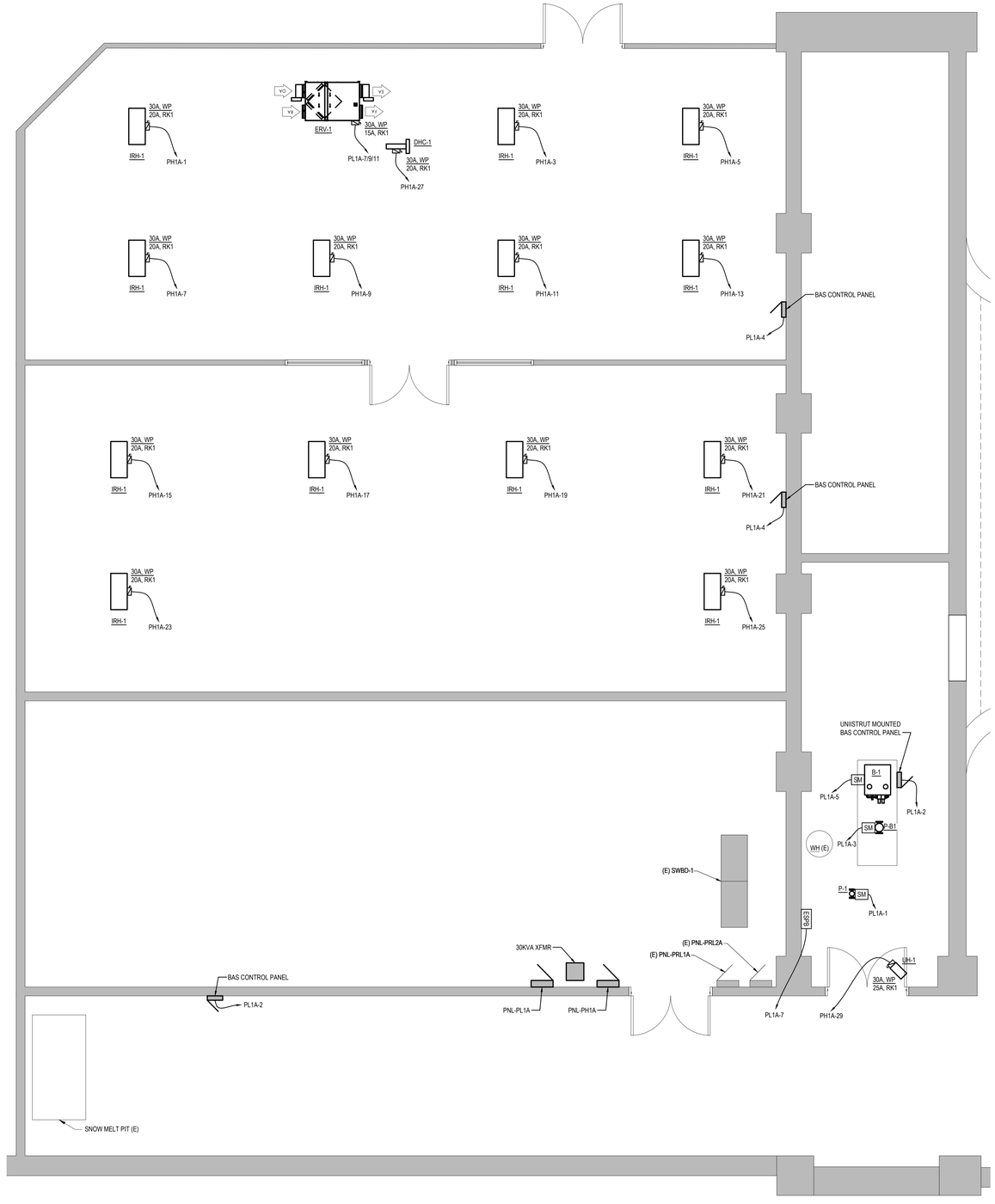


2 E-101 SCALE: 1/4" = 1'-0"

BOILER RM. ELECTRICAL DEMOLITION PLAN



KEY PLAN



3 E-101 SCALE: 1/4" = 1'-0"

SKATE SHOP ELECTRICAL NEW WORK PLAN

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CONSULTANT

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9/9/2021 3:12 PM