

RHODE ISLAND PUBLIC TRANSIT AUTHORITY

705 Elmwood Avenue
Providence, RI 02907

GENERAL GUIDELINES FOR COMPLETING INVITATION FOR BIDS PACKAGE

This document is intended as a guideline to assist prospective bidders in successfully completing the necessary Bid paperwork. You are strongly encouraged to read the Instructions for Bidders Sections very carefully. This document is NOT intended to replace the more-detailed instructions that are included in the attached Bid Package.

- It is **EXTREMELY IMPORTANT** that all required forms be filled out completely. Federal and State Regulations mandate that these forms be filled out properly. Failure to fill out these forms may result in your Bid being ruled non-responsive. Non Responsive Bids **will not** be awarded the contract.
- **REMEMBER to completely fill out** all REQUIRED FORMS (see REQUIRED FORMS Checklist). The forms that are checked off are the only ones that apply to this Bid. Please submit them in the correct order by Page Number.
- **In the event the Bid requests specific information; Please use the forms provided, attach additional sheets to the forms if necessary. DO NOT substitute your own forms.**
- If a form does not apply to your business or Bid please mark the form Not Applicable or some other similar wording at your discretion.
- DBE (Disadvantaged Business Enterprise) Obligation. RIPTA agrees to ensure that DBES, as outlined in 49 CFR Part 26, as amended, have the maximum opportunity to participate in the performance of contracts. Therefore, it is imperative that you read the DBE Section and complete the necessary Paperwork if DBEs are part of your Bid submittal. All DBEs submitted **must be certified by the State of Rhode Island** at the time of Bid submittal.
- Make Sure the Bid Response is received by the RIPTA Purchasing Department by the designated date and time. Late Bids will not be accepted
- It shall be the responsibility of prospective bidders to check the State of Rhode Island, Department of Administration Division of Purchases Website for any addenda.
- Make Sure that the Bid is returned in a **Sealed** Envelope or Box **CLEARLY LABELED** with the following Information: **Bid Number and what the Bid is for. This information should be in the lower left hand corner.** The envelope or box should also be labeled **Bid DOCUMENTS ENCLOSED**
- When in doubt, contact RIPTA Contracts Manager (401) 784-9500 extension 1214 for assistance.
- **Bid must be submitted pre-punched for standard three ring binders. A binder is not required. Spiral bound Bid submittals WILL NOT be allowed. Please note that United Parcel Service will not deliver to our address.**

Please refer to Page 85 for Technical Specifications

The following label shall be affixed to the envelope or package containing the Bid response documents. It is imperative that his label be affixed to insure the Bid documents are received and routed in the proper manner:

Return Address

BID DOCUMENTS ENCLOSED

CONTRACTS MANAGER
Rhode Island Public Transit Authority
Purchasing Department
Room 217
705 Elmwood Avenue
Providence, RI 02907

BID NUMBER: 20-05

BID FOR: Chaffee Building Rehabilitation

DUE: March 10, 2020

RHODE ISLAND PUBLIC TRANSIT AUTHORITY

705 Elmwood Avenue
Providence, RI 02907

REQUIRED COMPANY INFORMATION FORM

The following information is mandatory; Failure to complete this section may jeopardize your eligibility to be awarded the contract. **ALL SECTIONS OF THIS FORM MUST BE FILLED OUT COMPLETELY**

THIS INFORMATION IS REQUIRED IN ACCORDANCE WITH 49CFR 26.11

THIS FORM IS REQUIRED FOR ALL BIDDERS, PRIME CONTRACTORS, POTENTIAL SUBCONTRACTORS AND SUBCONTRACTORS

PLEASE PRINT OR TYPE YOUR INFORMATION

COMPANY NAME _____

COMPANY STREET ADDRESS: _____

COMPANY MAILING ADDRESS: _____

COMPANY REMIT TO ADDRESS: _____

COMPANY CONTACT PERSON: _____

COMPANY TELEPHONE NUMBER: _____

EMERGENCY 24 HOUR TELEPHONE NUMBER(S) (IF APPLICABLE): _____

COMPANY TELEFAX NUMBER: _____

COMPANY CONTACT EMAIL: _____

AGE OF THE FIRM (YEARS): _____

ANNUAL GROSS RECEIPTS (DOLLARS): _____

AVG 3 YEAR GROSS RECEIPTS LESS THAN 23.98 MILLION YES NO

IS YOUR FIRM CERTIFIED BY THE STATE OF RHODE ISLAND AS A DISADVANTAGED BUSINESS ENTERPRISE ? _____

DUNN AND BRADSTREET NUMBER: _____

NAICS CODE: _____ INDUSTRY _____

NAICS Code can be found at the following website: www.naics.com

COMPANY STATUS: PRIME CONTRACTOR SUBCONTRACTOR

RHODE ISLAND PUBLIC TRANSIT AUTHORITY
Invitation for Bids Number 20-05

INVITATION FOR BIDS

BID NO: 20-05

DATE OF INVITATION: February 10, 2020

PRE-BID MEETING: February 24, 2020

BID RECEIPT DATE: March 10, 2020

FURNISHING OF: Chaffee Building Rehabilitation

FEDERAL TRANSIT ADMINISTRATION PROJECT NO. qqq

The participant shall specify the official name of his/her company in the upper left-hand corner of the Bid Response Envelope and show **BID NO: and Bid Description in the lower left-hand corner and send or deliver to:**

**Purchasing Department
Room 217
705 Elmwood Avenue
Providence, RI 02907**

The participant shall execute the offer form enclosed herewith.

Bids will be reviewed and evaluated. All participants will be notified as soon as approval of award is made.

The Bidder shall execute the offer form enclosed herewith. The Bidder shall return **Two copy (ies)** with the **original** Bid.

RIPTA RESERVES THE RIGHT TO REJECT BIDS FROM PARTICIPANTS WHO HAVE NOT USED THE FORM AND PROPER BID RESPONSE ENVELOPE FORMAT.

RIPTA RESERVES THE RIGHT TO CANCEL ANY PARTICULAR SOLICITATION, AND/OR REJECT ANY OR ALL BIDS.

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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
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I. CALENDAR

A. Date of Invitation: February 10, 2020

B. Pre-Bid Conference:

1. **Date:** February 24, 2020

2. **Time:** 1:00 p.m. Eastern Time

3. **Place:** RIPTA Board Conference Room
269 Melrose Street, Providence, RI

Any and all appeals must be submitted in writing prior to the time and date set for the Pre-Bid Meeting.

C. Request for Approved equals and Questions

must be submitted **ELECTRONICALLY IN MICROSOFT WORD FORMAT** to RIPTA Contracts Manager by:

1. **Date:** February 28, 2020

2. **Time:** 1:00 p.m. Eastern Time

3. **Response to approved equals: 10 - 14 days prior to Bid opening.**

Please submit all of your questions in writing in one document by the deadline above; do not submit them piecemeal.

Requests for Approved Equals/Questions submitted after the deadline will NOT be considered

It should be noted that Requests for Approved Equals/Questions can be used for both questions regarding the technical specifications and regarding contractual terms and conditions

D. Bid Receipt:

1. **Date:** March 10, 2020

2. **Time:** 1:00 p.m. Eastern Time

RHODE ISLAND PUBLIC TRANSIT AUTHORITY
Invitation for Bids Number 20-05

II. NOTICE TO OFFERORS

A. DATE: February 10, 2020

The Rhode Island Public Transit Authority (RIPTA) is requesting Bids for the following:

Chaffee Building Rehabilitation

All Bids shall be submitted in the required format and quantity as set forth in the IFB. This Bid must be received by March 10, 2020 at 1:00 p.m. Eastern Time by the Purchasing Department, Room 217, 705 Elmwood Avenue Providence, Rhode Island 02907. **Please be advised that United Parcel Service does not deliver to this address.**

Award of contract is subject to financial assistance of 80% from the U.S. Department of Transportation (FTA Project qgg) and 20% from RIPTA. The successful Bidder shall comply with the conditions and terms applicable thereunder.

A Pre-Bid Meeting will be held at the RIPTA Transportation Building Conference Room, 269 Melrose Street Providence, RI at 1:00 pm Eastern Time on February 24, 2020.. bidders are expected to download and review the Bid Technical Specifications prior to the pre-Bid meeting.

The successful Bidder shall be required to comply with all applicable Equal Opportunity and Disadvantaged Business Enterprise regulations. bidders are encouraged to view the Rhode Island Minority Business Enterprise (RIMBE) website for a list of Disadvantaged Business Enterprise vendors that may be interested in working with your company on this Bid. All DBEs submitted must be certified by the State of Rhode Island at the time of Bid submittal.

The RIMBE Website address is: <http://odeo.ri.gov/offices/mbeco/dbe-program.php>

The Disadvantaged Business Enterprise goal for this project is: Not Applicable %

The successful Bidder shall be required to certify that he is not on the Comptroller General's List of Ineligible Contractors.

An electronic copy of the IFB is available on the State of Rhode Island, Department of Administration, Division of Purchases Website.

The website address is: www.purchasing.ri.gov/RIVIP/ExternalBidSearch.asp.

RIPTA Requests for Bids can be Public Bid Opportunities, Quasi Public Sector, listed under the Rhode Island Public Transit Authority. Bidders **must download the Bid documents and complete the required forms.**

If you are unable to access the Internet; a printed copy of the Bid may be obtained from RIPTA's Purchasing Department by calling Michael J. McGrane at (401) 784-9500, ext. 1214.

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III. CONTACT LIST

Please contact RIPTA's Contracts Manager with any questions you may have regarding this Procurement

A. Contracts Manager

Mr. Michael J. McGrane

Phone: (401) 784-9500 extension 1214

mmcgrane@ripta.com

All contacts with the Authority regarding this Procurement Action shall be directed to the RIPTA Contracts Manager. The Contracts Manager will contact the appropriate RIPTA Staff as needed. The Authority does not assume responsibility for the accuracy of information obtained from other RIPTA Staff.

Failure to adhere to this procedure may result in rejection of your Bid.

IV. PUBLIC COPY OF BID SUBMITTAL

Each Bidder must submit a copy of their bid submittal to be available for public inspection upon opening of the bids. The burden to identify and withhold from the public copy that is released at the bid opening any trade secrets, commercial or financial information or other information the bidder deems not subject to public disclosure pursuant to Chapter 38-2 of the Rhode Island Access to Public Records Act shall rest with the bidder submitting the bid.

V. ELECTRONIC COPY OF THE BID RESPONSE

Each Proposer must submit an electronic copy of their Bid Response. **The electronic version shall be CD or other electronic media.** This is in addition to the number of printed copies requested elsewhere in this document. **This must be submitted WITH the bid, NOT sent separately.**

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VI. INSTRUCTIONS FOR BIDDERS

A. Definition of Terms.

Whenever herein or in the Bid contract documents the following terms, pronouns or abbreviations are used, the intent and meaning shall be interpreted as follows:

1. **Procuring agency**
Procuring Agency is defined as the Rhode Island Public Transit Authority.
2. **RIPTA**
RIPTA shall refer to the Rhode Island Public Transit Authority.
3. **Contractor**
Contractor shall mean the successful Bidder to whom a contract is awarded.
4. **Invitation for Bids (IFB)**
Invitation for Bids shall mean the complete assembly of related documents, whether attached or incorporated by reference, furnished by RIPTA for the purpose of proposing, including the Invitation for Bids, the Instructions for Bidders, Supplemental Conditions, Specifications, Bid Form, Bid Attachments, and Addenda, if any. Bids shall be in strict accordance with the Terms of the IFB.
5. **Authorized Signature.**
The person who is executing this contract on behalf of the Bidder and who is authorized to bind the Bidder.
6. **Invitation for Bids.**
The advertisement of the issuance by RIPTA of an Invitation for Bids, which is published, posted and sent to prospective bidders informing interested persons of the proposed procurement.
7. **Bid Evaluation Factors/Criteria**
Evaluation Factors/Criteria given in the Technical Specifications are not listed in order of priority. The order of the listing has no relationship to the relative importance of the factors.
8. **Basis of Award**
The Contract will be awarded to the vendor that submits the Bid that is rated the overall best value to the Authority.
9. **Notice of Award.**
The receipt of a Purchase Order or Letter of Contract issued by RIPTA shall serve as notice of the award of contract.
10. **Specifications.**
The written description and statement of necessary requirements of the equipment/construction, supplies and/or service to be provided.
11. **Tender**
The Bidder's documents and all attachments tendered in response to the Bid requests.

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B. Form of Bid and Signature.

The Bid shall be presented with an original and Two copies on the forms provided herewith by RIPTA and shall be enclosed in a sealed envelope marked and addressed as required on the Bid form.

Depending upon whom the Bid is made by, the following signature and instructions must be followed:

1. Sole Owner.

Bid shall be signed with his full name, and his address shall be given.

2. General Partnership.

Bid shall be signed with the partnership name by a partner who shall also sign his/her own name, and the name and address of each partner shall be given.

3. Limited Partnership

Bid shall be signed with the partnership name by a general partner who has authorization to do so who shall also sign his/her own name.

4. Corporation.

Bid shall be signed by an officer or other individual who has the full and proper authorization to do so, and the corporate seal shall be affixed to the contract, or if the corporate seal is not affixed to the contract and it is signed by a person other than an officer, there must be attached to the contract a certified copy of a resolution of the corporation authorizing such officer or person to sign written contracts for and on behalf of the corporation.

C. Bid.

The terms of the Bid must not be changed. All blank spaces in said form shall be properly filled. Alterations by erasure or interlineation must be explained or noted in the Bid over the signature of the Bidder. If the unit price and the total amount named by a Bidder for any item, do not agree, **the unit price** alone will be considered as representing the Bidder's intention.

D. Unauthorized Conditions.

Unauthorized conditions, limitations or provisions attached to a Bid will render it informal and may cause its rejection.

E. Submission of Bid.

Prior to the hour specified in the Invitation for Bids inviting sealed Bids, all Bids shall be delivered to the Contracts Manager at the address shown in the Invitation for Bids. All costs associated with preparation and submission of a Bid shall be borne by the Bidder. The Authority assumes no responsibility for these costs

Each Bid shall be in a sealed envelope properly labeled on the outside with the Bid number and description. No Bids received after said time or at any place other than the time and place as stated in the Invitation for Bids will be considered. No Bid electronically transmitted , e.g. email and fax will be considered.

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F. Modification or Withdrawal of Bid.

A Bid may be modified or withdrawn by written or telegraphic notice received in the office designated in the Invitation for Bids not later than the exact time set for receiving of Bids. A telegraphic notice of modification or withdrawal of a Bid telephoned by the receiving telegraphic office no later than the set for opening of Bids will be considered if the message is confirmed by the telegraph company by sending a copy of a written telegram which formed the basis of the telephone call. A Bid may be withdrawn in person by a Bidder or his/her authorized representative provided his/her identity is made known and he signs a receipt for the Bid if the withdrawal is prior to the exact time set for receiving the Bids. Modifications of Bids and requests for withdrawal of Bids which are received in the office designated in the Invitation for Bids after the exact time set for opening are "late modifications" and "late withdrawals" respectively. A late modification or late withdrawal will be subject to the rules and procedures applicable to late Bids. A late modification of an otherwise successful Bid will be opened at any time it is received. If, in the judgment of the Director of Procurement, it makes the terms of the Bid more favorable to RIPTA, it will be presented to the Contract Manager and Director of Procurement for consideration.

G. Bidder Interviews or Presentations

The Authority reserves the right, at its sole discretion, to request Bid respondents to make presentations or interviews. This may be done in person, or through electronic means (i.e. telephone or via the internet). The purpose of this presentation is to enhance the presentation, not to amend it. bidders should prepare their Bid responses based upon the assumption that there will not be interviews, unless specifically stated in the Technical Specifications. The Written Bid should reflect their best effort.

H. Samples

Samples, when required, must be submitted within the time specified, at no expense to RIPTA. If not, destroyed or used up during testing, samples will be returned upon request at the Bidder's expense.

I. Canvass of Bids.

At the hour specified in the Invitation for Bids, a designee will receive the Bids. An award will be made or Bids rejected by RIPTA within the time specified in the specifications or Bid forms, or if not specified, within a reasonable time after Bids have been opened.

J. Rejection of Bids.

RIPTA reserves the right to reject any and all Bids. The right is reserved to reject any or all Bids, and to waive technical defects as the interest of RIPTA may require. Each Bidder shall be notified if all Bids are rejected.

K. Sales Tax Exemption.

RIPTA confirms there are no state, local or federal taxes applicable to this purchase.

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- L.** **Delivery Charges.**
Unless otherwise stated in the IFB, Bidders shall include freight and/or delivery charges in the total price of their Bids.
- M.** **Alternative Bid**
Submissions of an alternative Bid or Bids, except as specifically called for in the Specifications or IFB, will render the Bid informal and may cause its rejection.
- N.** **Non-Collusive Affidavit.**
The Bidder represents and warrants that its Bid is genuine and not sham or collusive or made in the interest or in behalf of any person not therein named, and that the Bidder has not, directly or indirectly, induced or solicited any other Bidder to submit a sham Bid or any other person, firm or corporation to refrain from proposing, and that the Bidder has not in any manner sought by collusion to secure itself an advantage over any other Bidder.
- O.** **Interest of RIPTA Personnel.**
The Bidder represents and warrants that neither the General Manager, nor any Board Member, nor any employee of RIPTA, is in any manner interested directly or indirectly in the Bid or in the contract, which may be made under it, or in any expected profits to arise therefrom.
- P.** **Penalty for Collusion.**
If at any time it shall be found that the person, firm or corporation to whom a contract has been awarded has, in presenting any Bid or Bids, colluded with any other party or parties, then the contract so awarded shall be **voidable** by RIPTA and the Contractor and his bondsmen shall be liable to RIPTA for all loss or damage which RIPTA may suffer thereby and the RIPTA Board may advertise for a new contract for said labor, supplies, materials, equipment or service.
- Q.** **Bid Acceptance Period**
All Bids shall remain in effect one hundred twenty (120) calendar days from the date of Bid opening. Bids offering less than one hundred twenty (120) calendar days for acceptance by RIPTA from the date set for opening will be considered non-responsive and will be rejected.
- R.** **Postponement.**
RIPTA reserves the right to postpone, for its own convenience, the date the Bid is to be received, but any Bidder whose Bid has already been submitted to RIPTA when the decision to postpone is made shall be afforded the opportunity to revise or withdraw its Bid.
- S.** **Amendment and/or Postponement.**
RIPTA reserves the right to revise or amend the specifications up to the time set for the receiving of Bids. Such revisions and addenda, if any, shall be announced by addenda to this solicitation. It shall be the responsibility of prospective bidders to check the State of Rhode Island, Department of Administration Division of Purchases Website for any addenda. If the revisions and addenda require changes in quantities or price Bid, or both, the date set for receiving Bids may be postponed by such number of days as in the opinion of RIPTA shall enable bidders to revise their Bids. In any case, Bid openings shall be

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at least seven (7) working days after the last addendum, and the addenda shall include an announcement of the new date, if applicable.

T. Single Bid.

1. In the event a single Bid is received, RIPTA will, at its option, either conduct a price and/or cost analysis of the Bid and make the award by negotiation or reject the Bid and re-advertise. A price analysis is the process of examining the Bid and evaluating a prospective price without evaluating the separate cost elements. Price analysis shall be performed by comparison of the price quotations submitted on other current quotations, with published price lists, or other established or competitive prices. The comparison shall be made to a purchase of similar quantity and involving similar specifications. Where a difference exists, a detailed analysis must be made of this difference and costs attached thereto.
2. Where it is impossible to obtain a valid price analysis, it may be necessary for RIPTA to conduct a cost analysis of the Bid price. Cost analysis is the review and evaluation of a contractor's cost or pricing data and of the factors applied in projecting from such data the estimated costs of performing the contract, assuming reasonable economy and efficiency.
3. The price and/or cost analysis shall be made by RIPTA's Procurement Department.

U. Qualifications for Award.

The Bidder must be a person, firm or corporation that:

1. Has in operation, or has the capability to have in operation, a manufacturing plant adequate to assure delivery of all equipment within the time specified under this contract.
2. Has adequate service personnel, or has the capability to have such personnel, to satisfy any service problems that may arise during the warranty period.
3. Has the necessary facilities and financial resources or has the capability to obtain such facilities and resources to complete the contract in a satisfactory manner within the required time.
4. The Procuring agency shall have the right to conduct a pre-award survey on each Bidder. Doubt as to the capability or technical ability, productive capacity or financial strength, which cannot be resolved affirmatively, shall require a determination of non-responsibility by RIPTA.

V. Ineligible Bidders.

The Bidder shall be required to certify, upon request, that it is not on the U.S. Comptroller General's Consolidated List of Persons or Firms currently Debarred for Violations of Various Public Contracts Incorporating Labor Standards Provisions.

W. Disadvantaged Business Enterprise (DBE)

The Rhode Island Public Transit Authority shall not discriminate on the basis of race, color, national origin, or sex in the award and performance of any DOT-assisted contract or in the administration of its

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DBE Program or the requirements of 49 CFR part 26. RIPTA will take all necessary and reasonable steps under 49 CFR part 26 to ensure nondiscrimination in the award and administration of DOT-assisted contracts. RIPTA's DBE Program, as required by 49 CFR part 26 and as approved by DOT, is incorporated herein by reference. Implementation of this DBE Program is a legal obligation and failure to carry out its terms shall be a violation of Federal law and a breach of any applicable DOT-assisted contract. Upon notification to RIPTA of its failure to carry out its approved DBE Program, the DOT may impose sanctions as provided for under 49 CFR part 26 and may, in appropriate cases where a firm/contractor makes a false or fraudulent statement in connection with participation of a DBE in any DOT assisted program or otherwise violates Federal law, refer the matter for prosecution under 18 U.S.C. 1001 and/or under 49 CFR Part 31, Program Fraud Civil Remedies Act. ..

X. Addenda.

RIPTA may issue addenda containing amendments to its Bid solicitation documents. Any addendum issued less than seven (7) days prior to the receipt of Bid shall, if necessary, contain a provision postponing the date of the receipt of Bid to a date that will provide bidders adequate time to respond to the addenda. Addenda shall be numbered sequentially.

Y. Bidder's Requests and Appeals.

1. Appointments.

Bidders and suppliers may make appointments with the contact person listed in the specifications to discuss the specifications.

2. Amending Materials.

Any amending material issued by RIPTA pertaining to the Bid solicitation documents (including, without limitation: clarifications, approved equals, and corrections) shall be set forth in an addendum and sent to all parties who are on record as having obtained a copy of the Bid solicitation documents.

3. Appeal.

Should any Bidder or supplier choose to appeal RIPTA's decision, such appeal must be in writing and received by RIPTA not less than seven (7) calendar days before the date of receipt of Bid. RIPTA has no obligation to consider appeals received less than seven (7) calendar days before the date of the receipt of Bid.

4. Withdrawal.

The Bidder or supplier may withdraw its appeal at any time before RIPTA issues a final decision. There shall be no further review of the appeal after the final decision is issued.

5. Notification.

Should RIPTA postpone the date of the receipt of Bid owing to the appeal, RIPTA shall notify all parties who are on record as having obtained a copy of the Bid solicitation documents that an appeal has been filed and that the date of the receipt of Bid shall

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be postponed until RIPTA has issued its final decision. RIPTA shall issue appropriate amendments postponing the re-scheduling date of the receipt of Bid.

Z. **Equal Employment Opportunity.**

In connection with the execution of this contract, the Contractor shall not discriminate against any employee or applicant for employment because of race, color, sex, age, national origin, religion, sexual orientation, gender identity or expression, disability status or veteran status. The Contractor shall take affirmative action to insure that applicants are employed and that employees are treated during their employment, without regard to their race, color, sex, age, national origin, religion, sexual orientation, gender identity or expression, disability status or veteran status. Such actions shall include, but not limited to, the following: employment, promotion, demotion, transfer, recruitment or recruitment advertising, layoff, or termination, rates of pay, or other forms of compensation, and selection for training, including apprenticeship.

AA. **Prohibited Interest.**

No member, officer, or employee of RIPTA or of a local public body during his tenure or for one year thereafter shall have any interest, directly or indirectly, in this contract or the proceeds thereof.

BB. **Interest of Members of Congress.**

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

CC. **Contract Commencement Date.**

The contract commencement date shall be the date of the signing of the Purchase Order or by Letter of Contract signed by an authorized RIPTA employee.

DD. **Notice, Waiver and Applicable Law.**

Notice given to Contractor and RIPTA shall be given to the parties in writing by certified mail at the respective addresses set forth herein. Waiver by RIPTA of a breach by Contractor of any provision of this contract shall not be deemed a waiver of future compliance therewith, and such provision as well of future provisions hereunder, shall remain in full force and effect. The rights and duties of the parties hereto shall be determined by the laws of the State of Rhode Island, and to that end this agreement shall be considered and construed as a contract made an to be performed in the State of Rhode Island.

EE. **Protest.**

1. General.

Protests will be accepted from prospective bidders or Offerors whose direct economic interest would be affected by the award of a Contract or by failure to award a contract. The RIPTA Director of Purchasing will consider all protests or objections filed in a timely manner regarding the award of a contract, whether submitted before or after award. If the protest is oral and the matter cannot be otherwise resolved, written confirmation of the

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protest will be requested. Protest submissions should be concise, logically arranged, and clearly state the grounds for the protest. Protests must include at least the following information:

- a. Name, address and telephone number of protester.
- b. Identification of the solicitation or Contract number.
- c. A detailed statement of the legal and factual grounds of protest, including copies of relevant documents
- d. A statement as to what relief is requested.
- e. Protest should be sent to:
Director of Procurement
RI Public Transit Authority
Room 217
705 Elmwood Avenue
Providence, RI 02907
- f. Protests must be filed with the RIPTA in accordance with our procedures and time requirements. The protest to RIPTA must be complete and contain all the issues that the protester believes relevant. RIPTA will respond to each substantive issue raised in the protest. Failure to include an issue in the protest eliminates that issue from further consideration. All protest decisions entered by RIPTA are final in accordance with FTA "Third Party Contract" Regulation.
- g. On occasion, when considered appropriate, an informal conference on the merits of the protest with all interested parties may be held.

FF. Protests Before Award

1. Solicitation Phase.

Protests concerning the solicitation must be submitted in writing five (5) working days prior to Bid opening or closing date for receipt of Bids. If the written protest is not received by the time specified, award may be made in the normal manner unless the Director of Purchasing, upon investigation, finds that remedial action is required. Oral protests not followed up by a written protest will be disregarded.

Notice of a protest and the basis therefore will be given to all potential bidders or Offerors.

2. Pre-Award Phase.

When a protest against the making of an award is received after receipt of Bids but prior to award, the Director of Purchasing may determine to withhold the award pending disposition of the protest. The bidders or bidders whose Bids might become eligible for award should be requested, before expiration of the time for acceptance of their Bids, to extend the time for acceptance (with consent of sureties, if any) to avoid the need for re-advertising. RIPTA will provide a written response to each material issue raised in the written protest.

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Where a written protest against the making of an award is received in the time specified, award will not be made prior to five (5) working days after resolution of the protest or, if a protest has been filed with FTA during the pendency of that protest, unless RIPTA determines that:

- a. The items to be procured are urgently required;
- b. Delivery or performance will be unduly delayed by failure to make award promptly; or,
- c. Failure to make award will otherwise cause undue harm to RIPTA or the Federal Government.

If award is made, the Director of Procurement will document the file to explain the need for an award, and will give written notice of the decision to proceed with the award to the protester and, as appropriate, to others concerned.

GG. Protests After Award.

A protest received not later than 10 (ten) working days after award shall be reviewed by the Director of Purchasing. The Contractor will in any event, be furnished with the notice of protest and the basis therefore. When it appears likely that an award may be invalidated and a delay in receiving the supplies or services is not prejudicial to the Authority's interest, the Director of Purchasing should consider a mutual agreement with the Contractor to suspend performance on a no-cost basis.

HH. Source Selection and Contract Award

The contract shall be awarded with reasonable promptness by written notice to the responsive and responsible Bidder whose Bid will be evaluated using a best value approach. The ultimate selection of an offeror will be on the basis of overall best value to the Authority.

II. Title VI Assurances

Contractors and subcontractors will be required to comply with all requirements imposed by Title VI of the Civil Rights Act of 1964 (49 U.S.C. §2000d, et seq.), and the Assurances by RIPTA pursuant thereto.

JJ. Energy Conservation Requirements:

The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency, which are contained in the State of Rhode Island Energy Conservation Plan issued in compliance with the Energy Policy and Conservation Act.

KK. Program Fraud

1. The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S. C. § §3801 et. seq. and U. S. Department of Transportation regulations. "Program Fraud Civil Remedies" 49 C.F. R. Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made , it makes, it may make, or causes to be made, pertaining to the underlying contract or the Federal Transit Administration assisted project for which this contract work is being performed. In

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addition to other penalties that may be applicable, the Contractor further acknowledges that if it make, or causes to be made, a false , fictitious or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

2. The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by the FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 5307 (n) (1) on the Contractor, to the extend the Federal Government deems appropriate.
3. The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

LL. No Government Obligation to Third Parties:

1. The Purchaser and the Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the Purchaser, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.
2. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

MM. Veteran's Employment

The Contractor shall ensure that contractors working this project shall give a hiring preference, to the extent practicable, to veterans (as defined in Section 2108 of title 5) who have the requisite skills and abilities to perform the work required under the contract. This shall not be understood, construed or enforced in any manner that would require an employer to give a preference to any veteran over any equally qualified applicant who is a member of any racial or ethnic minority, female, an individual with a disability, or a former employee.

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VII. GENERAL PROVISIONS

A. Definitions:

As used throughout this Contract, the following terms shall have the meanings set forth below:

1. Authority

Authority means Rhode Island Public Transit Authority (RIPTA).

2. Contracting Manager

the person executing this Contract on behalf of the Authority, and his or her successor, and the term includes, except as otherwise provided in this Contract, the authorized representative of a Contracting Officer acting within the limits of his authority.

3. Directed, Ordered, designated or prescribed

Wherever in the scope of the work the words directed, ordered, designated, prescribed, or words of like importance are used, it shall be understood that the direction, requirement, order, designation, or prescription of the Contracting Manager is intended and similarly the words approved, acceptable, satisfactory, or words of like importance shall mean approved by, or acceptable to, satisfactory to the Contracting Officer, unless expressly stated.

B. Changes:

The Contracting Officer may at any time, by a written order, and without notice to the sureties, make changes within the general scope of this Contract. If any such changes causes an increase or decrease in the cost of, or the time required for, the performance of any part of the work under this Contract, whether changed or not changed by the order, the Contracting officer shall make an equitable adjustment in the Contract price, the delivery schedule, or both, and shall modify the Contract.

The Contractor must assert its right to an adjustment under this article within 30 days from the date of receipt of the written order. Failure to agree to any adjustment shall be a dispute under the Disputes article. However, nothing in this article shall excuse the Contractor from proceeding with the contract as changed.

C. Extras:

Except as otherwise provided in this Contract, no payment for extras shall be made unless such extras and the price therefore have been authorized in writing in advance by the Contracting Officer.

D. Inspection:

All supplies, which term throughout this article includes without limitation raw materials, components, intermediate assemblies, and end products, shall be subject to inspection and test by the Authority, to the extent practicable at all times and places including the period of manufacture, and in any event prior to acceptance.

In case any supplies or lots of supplies are defective in material or workmanship or otherwise not in conformity within the requirements of this Contract, the Authority shall have the right either to reject them or

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require their correction. If any inspection or test is made by the Authority on the premises of the Contractor or a subcontractor, the Contractor without additional charge shall provide all reasonable facilities and assistance for the safety and convenience of the Authority inspectors in the performance of their duties.

All inspections and test by the Authority shall be performed in such a manner as not to unduly delay this work. The Authority reserves the right to charge to the Contractor any additional cost of Authority inspection and test when supplies are not ready at the time such inspection and test is requested by the Contractor or when re-inspection or retest is necessitated by prior rejection. Acceptance or rejection of the supplies shall be made as promptly as practicable after delivery, except as otherwise provided in this Contract; but failure to inspect and accept or reject supplies shall neither relieve the Contractor from responsibility for such supplies as are not in accordance with the contract requirements nor impose liability on the Authority therefore. The inspection and test by the Authority of any supplies or lots thereof does not relieve the Contractor from any responsibility regarding defects or other failures to meet the Contract requirements, which may be discovered prior to acceptance. Except as otherwise provided in this Contract, acceptance shall be conclusive except as regard latent defects, fraud, or such gross mistakes as amount to fraud. The Contractor shall provide and maintain an inspection system acceptable to the Authority covering the supplies hereunder. Records of all inspection work by the Contractor shall be kept complete and available to the Authority during the performance of this Contract and for such longer period as may be specified elsewhere in this Contract.

E. Responsible:

Notwithstanding the requirements for any Authority inspection and test contained in Specifications applicable to this Contract, except where specialized inspections or tests are specified for performance solely by the Authority, the Contractor shall perform or have performed the inspections and tests required to substantiate that the supplies and services provided under the contract conform to the Drawing, Specifications and Contract requirements.

F. Title and Risk of Loss

Unless this Contract specifically provides for earlier passage of title, title to supplies covered by this Contract shall pass to the Authority upon formal acceptance. Unless this Contract specifically provides otherwise, risk of loss of or damage to supplies covered by this Contract shall remain with the Contractor, until acceptance by the Authority.

Notwithstanding the above, the risk of loss of or damage to supplies which so fail to conform to the Contract as to give a right of rejection shall remain with the Contractor until cure or acceptance, at which time the above shall apply.

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G. Storage of Contractor Material on RIPTA Property

The Authority will not accept responsibility for any Contractor Material stored on RIPTA Property. It shall be the responsibility to provide a secure, method of storing their material on RIPTA Property.

H. Payments

The Contractor shall be paid, upon the submission of proper invoices or vouchers, the prices stipulated herein for supplies delivered and accepted or services rendered and accepted, less deductions, if any, as specified. The failure to perform may result in partial or full suspension of payment and/or process payment. The Authority's payment terms are 60 days after approval of an invoice unless otherwise negotiated.

I. Stop Work Order

The Contracting Manager may, at any time, by written order to the Contractor, require the Contractor to stop all, or part of the work called for by this Contract. Any such order shall be specifically identified as a STOP WORK ORDER issued pursuant to this article. Upon receipt of such an order, the Contractor shall forthwith comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage.

J. Disputes

1. Except as otherwise provided in this Contract, any dispute concerning a question of fact arising under this Contract which is not disposed of by agreement shall be decided by the Contracting Officer, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Contracting Officer shall be final and conclusive unless, within 30 days from the date of receipt of such copy, the Contractor mails or otherwise furnishes to the Contracting Officer a written appeal addressed to the General Manager. The decision of the General Manager or his/her duly authorized representative for the determination of such appeals shall be final and conclusive unless determined by a court of competent jurisdiction to have been fraudulent, or capricious, or arbitrary, or so grossly erroneous as necessarily to imply bad faith, or is not supported by substantial evidence. In connection with any appeal proceeding under this article, the Contractor shall be awarded an opportunity to be heard and to offer evidence in support of his appeal. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the contract and in accordance with the Contracting Officer's decision.
- 2 This **DISPUTES** article does not preclude consideration of questions of law in connection with decisions provided for in paragraph a. above. Nothing in this Contract, however, shall be construed as making the final decisions of the General Manger of his/her representative on a question of law.

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K. **Default**

1. The Authority may, subject to the provisions of paragraph b. below, by written notice of default to the Contractor, terminate the whole or any part of this Contract in any one of the following circumstances:
 - a. If the Contractor fails to make delivery of the supplies or to satisfactorily perform the services within the time specified herein or any extension thereof; or
 - b. If the Contractor fails to perform any of the other provisions of this Contractor, or so fails to make its terms, and in either of these two circumstances does not cure such failure within a period of 10 days (or such longer period of as the Contracting Officer may authorize in writing) after receipt of notice from the Contracting Officer specifying such failure
2. Default without the fault or negligence of the Contractor. Such causes may include, but are restricted to, acts of God or of the public enemy, acts of the Government in its sovereign capacity or the Authority in its contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the Contractor.
3. If the Contractor fails to deliver the supplies or satisfactorily perform the services within the time specified in this Contract, or any extension thereof, the actual damage to the Authority for the delay will be difficult or impossible to determine. Therefore in lieu of actual damages, the Contractor shall pay to the Authority as fixed, agreed and liquidated damages for each calendar day of delay, the amount set forth elsewhere in this Contract. The Contractor shall not be charged with liquidated damages when the delay arises out of causes beyond the control and without the fault or negligence of the Contractor, and in such event, subject to this DISPUTES article, the Contracting Officer shall ascertain the facts and extent of the delay and shall extend the time for performance of the contract when in his judgment the findings of fact justify an extension.
4. The rights and remedies of the Authority provided in this article shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

L. **Termination for Convenience of the Authority**

The performance of work under this Contract may be terminated by the Authority in accordance with this article in whole, or from time to time in part, whenever the Contracting Officer shall determine that such termination is in the best interest of the Authority. Any such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which performance of work under the contract is

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terminated, and the date upon which such termination becomes effective.

After receipt of a Notice of Termination, the Contractor shall submit to the Contracting Officer his termination claim, in the form and with certification prescribed by the Contracting Officer. Such claims shall be submitted promptly by in no event later than one year from the effective date of termination. Upon failure of the Contractor to submit his termination claim within the time allowed, the Contracting Officer may, subject to any review required by the contracting agency's procedures in effect as of the date of execution of this Contract, determine, on the basis of information available to him, the amount, if any, due the Contractor by reason of the termination and shall thereupon pay to the Contractor the amount so determined.

In the event of the failure of the Contractor and the Contracting Officer to agree upon the whole amount to be paid the Contractor by reason of the termination of work pursuant to this article, the Contracting Officer shall, subject to any review by the contracting agency's procedures in effect as of the date of execution of this Contract, determine, on the basis of information available to him, the amount if any, due the Contractor by reason of the termination.

Costs claimed, agreed to , or determined pursuant to this paragraph shall be in accordance with the applicable with the applicable contract cost principles and procedures of the Federal Acquisition Regulations (48 CFR 31.1) in effect on the date of this Contract. The Contractor shall have the right to appeal, under the DISPUTES article of this Contract from any determination made by the Contracting Officer, except that, if the Contractor has failed to submit his claim within the time provided above and has failed t request extension of such time, he shall have no such right of appeal. Unless otherwise provided for in this Contract, or by applicable statue, the Contractor, from the effective date of termination and for a period of three years after final settlement under this Contract, shall preserve and make available to the Authority at all reasonable times at the office of the Contractor but without direct charge to the Authority, all his books, records, documents, and other evidence bearing on the costs and expenses of the Contractor under this Contract and relating to the work terminated hereunder, or, to the extent approved by the Contracting Officer, photographs, micro photographs, or other authentic reproductions thereof.

M. Federal, State and Local Taxes

Except as may be otherwise provided in this Contract, the Contract price includes all applicable Federal, State, and Local taxed and duties. The Authority upon the request of the Contractor shall, without further liability, furnish evidence appropriate to establish exemption from any Federal, State, or Local tax.

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N. **Walsh-Healey Public Contracts Act**

If this contract is for the manufacture or furnishing of materials, supplies articles, or equipment in an amount which exceeds or may exceeds or exceed \$15,000 and is otherwise subject to the Walsh-Healey Public Contract Act, as amended (41 U.S.C. 34-35), there are hereby incorporated by reference all representations and stipulations required by said Act and regulations issued thereunder by the Secretary of Labor, such representations of the Secretary of Labor which are now or may hereafter be in effect.

O. **Officials Not to Benefit**

No member, officer, or employee of the Authority during his tenure or one year thereafter shall have any interest, direct or indirect, in this Contract or the proceeds thereof.

P. **Covenant against Contingent Fees**

The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this Contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty, the Authority shall have the right to annul this Contract without liability or in its discretion, to full amount of such commission, percentage, brokerage, or contingent fee.

Q. **Notice to the Authority of Labor Disputes**

Whenever the Contractor has knowledge that any or potential labor disputes is delaying or threatens to delay the timely performance of this Contract, the Contractor shall immediately give notice thereof, including all relevant information with respect thereto, to the Contracting Officer. The Contractor agrees to insert the substance of this clause, in any subcontract hereunder as to which a labor dispute may delay the timely performance of this Contract; except that each such subcontract shall provide that in the event its timely performance is delayed or threatened by delay by any actual or potential labor dispute, the subcontractor shall immediately notify his next higher tier subcontractor, or the Contractor, as the case may be, of all relevant information with respect to such dispute.

R. **Patent Indemnity**

1. If the amount of this Contract is in excess of \$10,000, the Contractor shall indemnify the Authority and its officers, agents, and employees against liability, including costs, for infringement of any United States letters patent arising out of the manufacture or delivery of supplies under this Contract.
2. In addition, if specifically requested by the Contracting Officer prior to execution of the Contract, a copy of the current license agreement and identification of applicable claims of specific patents shall be furnished.

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S. Use of Trade Names

Any trade names used in this document are merely used for a point of reference. The Authority will consider submission of approved equals on any or all products specified. Use of trade names by the Authority bears no actual or implicit approval for the violation of any current or pending patents or copyrights.

T. Rights in Technical Data

1. The Authority shall have the right to use, duplicate or disclose technical data, which includes computer software, in whole or in part, in any manner and for any purpose whatsoever, and to have or permit others to do so:
 - a. Any manuals, instructional materials prepared for installation, operation, maintenance or training purposes;
 - b. Technical data pertaining to end items, components or processes which were prepared for the purpose of identifying sources, size, configuration, mating and attachment characteristics, functional characteristics and performance requirements ("for, fit and function: data; e/g/ specification control drawing, catalog sheets, outline drawing; except that for computer software it means data identifying source, functional characteristics, and performance requirements but specifically excludes the source code, algorithm, process, formulae, and flow charts of the software);
 - c. Other technical data which has been, or is normally furnished without restriction by the Contractor or subcontractor;
 - d. Other specifically described technical data, which the parties have agreed will be furnished without restriction.
2. The Authority shall have the right to use, duplicate, or disclose technical data other than that defined in paragraph a. in whole or in part, with the express limitation that such technical data shall not, without the written permission of the party furnishing such technical data, be
 - a. released or disclosed in part by the Authority for manufacture, or
 - b. used in whole or in part by the Authority for manufacture, or
 - c. used by a party other than the Authority except for emergency repair or overhaul work only, by or for the Authority where the item or process concerned is not otherwise reasonably available to enable timely performance of the work; provided, that the release or disclosure thereof outside the Authority shall be made subject to a prohibition against further use, release or disclosure.
3. Technical data provided in accordance with the provisions of paragraph b. shall be identified by a legend, which suitably

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recites the aforesaid limitation. Nothing herein shall impair the right of the Authority to use similar or identical data acquired from other sources.

4. The term technical data as used in this article means technical writing, computer software, sound recording, pictorial reproductions, drawings, or other representations and works of a technical nature, whether or not copyrighted, which are specified to be delivered pursuant to this Contract. The term does not include financial reports, cost analysis, and other information incidental to Contract administration. Computer software as used in this article means computer programs, computer databases, and documentation.
5. Material covered by copyright:
 - a. The Contractor agrees to and does hereby grant to the Authority, and to its officers, agents and employees acting within the scope of their official duties, a royalty-free, nonexclusive and irrevocable license throughout the world for Authority purposes to publish, translate, reproduce, deliver, perform, dispose of, and to authorize others to do so, all technical data now or hereafter covered by copyright.
 - b. No such copyright matter shall be included in technical data furnished hereunder without the written permission of the copyright owner for the Authority (or higher-tier contractor) promptly and in reasonable written detail each notice or claim of copyright infringement received by the Contractor with respect to any technical data delivered hereunder.
6. Relation to patents: Nothing contained in this article shall imply a license to the Authority under any patent, or be construed as affecting the scope of any license or other right otherwise granted to the Authority under any patent.
7. Any dispute under this article shall be subject to the Disputes article of this contract

U. Audit and Inspection of Records

The Contractor shall maintain records, and the Contracting Officer, the State of Rhode Island, the U.S. Department of Transportation, and the Comptroller General of the United States or any of their duly authorized representatives shall, until the expiration of three years after final payment under this Contract, have access to and the right to examine any directly pertinent books, documents, papers and records of such contractor, involving transactions related to the Contract, for the purpose of making audit, examination, excerpts and transactions. The Contractor further agrees to include in all his subcontracts hereunder a provision to the effect that the subcontractor agrees that the Contracting Officer, the State of Rhode Island, the U.S. Department of Transportation and the Comptroller General of the United States or any of their Duly authorized representatives shall, until the expiration of

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three years after final payment under the Contract, have access to and the right to examine any directly pertinent books, documents, papers and records of such subcontractor, involving transactions related to the subcontract, for the purpose of making audit, examination, excerpts and transcription.

V. Gratuities

In connection with performance of work required under this Contract, or any changes or modifications relative thereto, the giving of or offering to give gratuities (in the form of entertainment, gifts or otherwise) by the Contractor, or any agent, representative or other person deemed to be acting on behalf of the Contractor, or any supplier or subcontractor furnishing material to or performing work under this Contract, or agent, representative or other person deemed to be acting on behalf of such supplier or subcontractor, to any Director, Officer or employee of the Authority; or to any Director, employee or agent of any of the Authority's agents, consultants, representatives or other persons deemed to be acting for or on behalf of the Authority with a view toward securing a contract or securing favorable treatment with respect to the awarding to the awarding or amending, or the making of any determinations with respect to the performing of such contract is expressly forbidden. The terms of this GRATUITIES article shall be strictly construed and enforced in the event of violations hereto.

W. Limitation on Withholding Payments

If more than one article or schedule provision of this Contract authorized the temporary withholding of amounts otherwise payable to the Contractor for supplies delivered or services performed, the total of the amounts so withheld at any one time shall not exceed the greatest amount which may be withheld under any one such article or schedule provision at that time; provided, that this limitation shall not apply to:

1. Withholdings pursuant to any clause relating to wages or hours of employees;
2. Withholdings not specifically provided for by this Contract; and
3. The recovery of overpayment.

X. New Material

The Contractor represents that the supplies and components to be provided under this Contract are new (not used or reconditioned, and not of such age or so deteriorated as to impair their usefulness or safety).

Y. Order of Precedence

In the event of an inconsistency in the Contract, unless otherwise provided herein, the inconsistency shall be resolved by giving precedence in the following order:

1. The Bid Schedule;
2. Special Conditions;
3. General Provisions;
4. The other provisions of the Contract, whether incorporated by reference or otherwise;
5. The Specifications; and

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6. Drawings.

Z. **Correction of Deficiencies**

1. Definitions:

As used in this article:

- a. Deficiency means any condition or characteristics in any supplies (which term shall include related technical data) or services furnished hereunder, which is not in compliance with the requirements of this Contract.
- b. Correction means any and all actions necessary to eliminate any and all deficiencies.
- c. Supplies mean the end item(s) furnished by the Contractor and related services required under this Contract.

2. General:

- a. The rights and remedies of the Authority shall not be affected in any way by any other provisions under this Contract concerning the conclusiveness of inspection and acceptance.
- b. The Contractor shall not be responsible under this article for the correction of deficiencies caused by the Authority. These shall be no extension in time for performance; no increase in contract price for the correction of deficiencies that are the responsibility of the Contractor, his suppliers, and/or subcontractors.

3. Deficiencies in accepted supplies or services:

If the Contracting Officer determines that a deficiency exists in any of the supplies or services accepted by the Authority under this Contract, he shall promptly notify the Contractor of the deficiency, in writing, within 30 days. Upon timely notification of the existence of such a deficiency, or if the Contractor independently discovers a deficiency in accepted supplies or services, the Contractor shall promptly submit to the Contracting Officer his recommendation for corrective actions, together with supporting information in sufficient detail for the Contracting Officer to determine what corrective action, if any, shall be undertaken.

4. Correction of Deficiencies by Contractor:

The Contractor shall promptly comply with any timely written direction by the Contracting Officer to correct or partially correct a deficiency, at no increase in the Contract price. The Contractor shall also prepare and furnish to the Authority data and reports applicable to any correction required under this article (including revision and updating of all other affected data called for under this Contract) at no increase in the Contract price.

5. Deficiencies in supplies or services not yet accepted:

If the Contractor becomes aware at any time before acceptance by the Authority (whether before or after tender to the Authority) that a deficiency exists in any supplies or services, he shall

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promptly correct the deficiency or, if he elects to invoke the procedures in paragraph c. above he shall promptly communicate information concerning the deficiency to the Contracting Officer, in writing, together with his detailed recommendation for corrective action.

6. Extensions or Delays

In no event shall the Authority be responsible for extension or delays in the scheduled deliveries or periods of performance under this Contract as a result of the Contractor's obligations to correct deficiencies, nor shall there be any adjustment of delivery schedule or period of performance as a result of corrections of deficiencies, except as may be agreed to by the Authority in a supplemental agreement with adequate consideration.

7. Contract Price

It is hereby specifically recognized and agreed by the parties hereto that this article shall not be construed as obligating the Authority to increase the Contract price of this Contract.

8. Failure to correct:

If the Contractor fails or refuses to promptly rectify the deficiency the Contracting Officer shall give the Contractor written notice specifying the failure or refusal and setting a period after receipt of the notice within which it must be cured. If the failure or refusal is not cured within the specified period, the Contracting Officer may, by contract or otherwise, as required:

- a. Obtain detailed recommendations for corrective action;
- b. Correct the supplies or services, or
- c. Replace the supplies or services; and if the Contractor fails to furnish timely disposition instructions, the Contracting Officer may dispose of nonconforming supplies for the Contractor's account in a reasonable manner, in which case the Authority is entitled to reimbursement from the Contractor or from the proceeds for the reasonable expenses of case and disposition, as well as for excess costs incurred or to be incurred; and
- d. Obtain applicable data and reports; and charge to the Contractor the cost occasioned the Authority thereby.
- e. Impose Liquidated Damages in accordance the terms of this document
- f. Terminate the contract. Termination of contract by RIPTA does not relieve the contractor of any liquidated damages imposed by the Authority.

AA. Assignment

1. The Contractor shall not transfer the rights and obligations of the Contract to third parties without the prior written approval of the Authority's Contracting Officer. After review of facts and circumstances without exception the assignment shall not be approved unless the surety, in writing, agrees to that assignment

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- and accepts the assignee as the Contractor and principal on the payment and/or performance bonds.
2. If this Contract provides for payments aggregating \$1,000 or more, claims for monies due or to become due the Contractor from the Authority under this Contract may be assigned to a bank, trust company, or other financing institution, including any Federal lending agency, any may thereafter by further assigned and reassigned to any institution. (Notice of such assignment shall be made to the Authority.) Any such assignment or reassignment shall cover all amounts payable under this Contract and not already paid, and shall not be made to more than one party, except that any such assignment or reassignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. It is the Authority's intent to recognize only bona fide lending institutions, therefore, assignment to any private corporation, business or individual, which does not qualify as such, is specifically prohibited.
 3. Any attempt to transfer by assignment not authorized by this article shall constitute a breach of the Contract and the Authority may for such cause terminate the right of the Contractor to proceed as provided in the DEFAULT article of these General Provisions, and the Contractor and his sureties shall be liable to the Authority for any excess costs incurred by the Authority.
 4. The Rhode Island Public Transit Authority may assign some or all of its rights to purchase the items specified in this contract to one or more third parties, provided, however, that nay such assignment shall not relieve RIPTA of its obligations under this contract unless otherwise agreed to by Contractor in writing.

BB. Certificates of Current Cost or Pricing Data

The Contractor shall provide a Certificate of Current Cost or Pricing Data as required in Subpart 15.804 of the Federal Acquisition Regulations (48 CFR 15.804) in support of any negotiated contract expected to exceed \$100,000 any modification to a formally advertised or negotiated contract on which the aggregate of the increase and decrease in cost are expected to exceed \$100,000; the Contracting Officer at his discretion may request cost or pricing data for modifications on which cost are \$100,000 or less and an attendant certificate of current cost or pricing data.

CC. Cargo Preference

Use of United States Flag Vessels

Pursuant to Pub. L 664 (56 U.S.C. 1241 (b)):

"Cargo Preference-Use of United States-Flag Vessels

The Contractor agrees

1. To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk cargo liners, and tankers) involved, whenever shipping any equipment, materials, or commodities

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pursuant to this Contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

2. To furnish within 20 days following the date of loading for shipments originating within the United States, or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (1) above to the Grantee (through the prime Contractor in the care of subcontractor bills-of lading) and to the Division of National Cargo, Officer of Market Development, Maritime Administration, Washington, D.C. 20230, marked with appropriate identification of the Project.
3. To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this Contract.

DD. Buy America Act

The Contractor agrees to comply with 49 U.S.C. §533(j), and its implementing regulations at 49 C.F.R. Part 661, any amendments thereto, and any implementing guidelines issued by FTA.

EE. Equal Opportunity

1. Race, Color, Creed, National Origin, Sex.

In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOL) regulations, " Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 CFR Parts 60 et seq., (which implements Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders regulations, and Federal polices that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, colorreligion, sex or national origin. Such action shall include, but not be limited to, the following: employment, promotion, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

2. Age

In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29, U.S.C. § 623 and

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Federal Transit Law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

3. Disabilities

In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

The contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

FF. Nondiscrimination under Federal Grants

In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. §2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. §6102, section 202 of the Americans with Disabilities Act of 1990, 42 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it shall not discriminate against any employee or applicant for employment because of race, color,, religion, age, national origin, sexual orientation, disability, gender identity or expression or veteran status. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

GG. Rights in Data and Copyrights-FTA (June 1996)

The term "subject data" used in this section means recorded information, whether or not copyrighted, that is delivered or specified to be delivered under this contract. The term includes graphic or pictorial delineation in media such as drawings or photographs; text in specifications or related performance or design-type documents; machine forms such as punched cards, magnetic tape, or computer memory printouts; and information retained in computer memory. Example include, but are not limited to: computer software, engineering drawings and associated lists, specifications, standards, process sheets, manuals, technical reports, catalog item identifications, and related information. The term "subject data" does not include financial reports, cost analyses, and similar information incidental to Project administration.

When the Federal Transit Administration (FTA) provides financial assistance for a planning, research, development, or a demonstration project, it is FTA's general intention to increase mass transportation knowledge, rather than limit the benefits of the Project to participants in the Project. Therefore, unless FTA determines otherwise, the

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Contractor agrees that FTA may make available to any FTA recipient, sub-recipient, third party contractor, or third party subcontractor, either FTA's license in the copyright to the subject data derived under this contract or a copy of the subject data as defined in subsection a. of this clause and shall be delivered as the Government may direct. Unless prohibited by state law, the Contractor agrees to indemnify, save, and hold harmless RIPTA and the Government, their officers, agents, and employees acting within the scope of their official duties against any liability, including costs and expenses, resulting from any willful or intentional violation by the contractor of proprietary rights, copyrights, or right of privacy, arising out of the publication, translation, reproduction, delivery, use, or disposition of any data furnished under this Contract. The Contractor shall not be required to indemnify RIPTA and the Government for any such liability arising out of the wrongful acts of employees or agents of RIPTA and the Government.

HH. Davis-Bacon Act

40 USC &167; 276a -276a-5 (1998) 29 CFR § 5 (1999)

1. Minimum wages

- a. All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in

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29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

- b. The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
 - i. Except with respect to helpers as defined as 29 CFR 5.2(n)(4), the work to be performed by the classification requested is not performed by a classification in the wage determination; and
 - ii. The classification is utilized in the area by the construction industry; and
 - iii. The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and
 - iv. With respect to helpers as defined in 29 CFR 5.2(n)(4), such a classification prevails in the area in which the work is performed.
- c. If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- d. In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives,

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and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

- e. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.
- f. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
- g. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.
- h. The contracting officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
 - i. The work to be performed by the classification requested is not performed by a classification in the wage determination; and
 - ii. The classification is utilized in the area by the construction industry; and
 - iii. The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to

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the wage rates contained in the wage determination.

- i. If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- j. In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination with 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- k. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(v) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

2. Withholding

The Rhode Island Public Transit Authority shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice,

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trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the Rhode Island Public Transit Authority may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. i. The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Rhode Island Public Transit Authority for transmission to the Federal Transit Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR part 5. This information may be submitted in any form desired. Optional Form WH-347 is available for this

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- purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, DC 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.
- ii. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:
 - (1) That the payroll for the payroll period contains the information required to be maintained under 29 CFR part 5 and that such information is correct and complete;
 - (2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;
 - (3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.
 - c. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.
 - d. The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Federal Transit Administration or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor,

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sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

- a. Apprentices - Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the

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applicable classification. If the Administrator of the Wage and Hour Division of the U.S. Department of Labor determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- b. Trainees - Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined

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rate for the work performed until an acceptable program is approved.

- c. Equal employment opportunity - The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

5. **Compliance with Copeland Act requirements**

The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. **Subcontracts**

The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the Federal Transit Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. **Contract termination: debarment**

A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. **Compliance with Davis-Bacon and Related Act requirements**

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. **Disputes concerning labor standards**

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. **Certification of eligibility.**

- a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

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

II. Contract Work Hours and Safety Standards Act
40 U.S.C. 327-333 (1995) 29C.F.R. 5 (1995) 29 C.F.R. 1926 (1995)

1. Overtime requirements

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such to work in excess of forty hours in such workweek unless such laborers or mechanics receive compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability unpaid wages; liquidated damages

In the event of any violation of the clauses set forth in paragraph (1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clauses set forth in paragraph (1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clauses set forth in paragraph (1) of this section.

3. Withholding for unpaid wages; liquidated damages

The Rhode Island Public Transit Authority shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clauses set forth in paragraph (2) of this section.

4. Subcontracts

The contractor or subcontractor shall insert in any subcontracts the clauses set forth in this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in this section. (Section 102 non construction contracts should also have the following provision:)

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5. Payrolls and basic records

Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the names, address, and social security number of each worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Beacon Act), daily and weekly number of hours worked, deductions. Whenever the made and actual wages paid Secretary of labor has found under 29 CFR 5.5 (a)(1)(iv) that the wages of any laborer or mechanic included the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Beacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

6. Contract Work Hours and Safety Standards Act

The contractor agrees to comply with section 107 of the Contract Work Hours and Safety Standards Act, 40 U.S.C. section 333, and applicable DOL regulations, "Safety and Health Regulations for Construction" 29 C.F.R. Part 1926. Among other things, the Contractor agrees that it will not require any laborer or mechanic to work in unsanitary, hazardous, or dangerous surroundings or working conditions.

7. Subcontracts

The Contractor also agrees to include the requirements of the section in each. The term "subcontract" under this section is considered to refer to a person who agrees to perform any part of the labor or material requirements of a contract for construction, alteration or repair. A person who undertakes to perform a portion of a contract involving the furnishing of supplies or materials will be considered a "subcontractor" under this section if the work in question involves the performance of construction work and is to be performed: (1) directly on or near the construction site, or (2) by the employer for the specific

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project on a customized basis. Thus, a supplier of materials, which will become an integral part of the construction is a “subcontractor” if the supplier fabricates or assembles the goods or materials in question specifically for the construction project and the work involved may said to be construction activity. If goods or materials in question are ordinarily sold to other customers from regular inventory, the supplier is not a “subcontractor.” The requirements of this section do not apply to contracts or subcontracts for the purchase of supplies or materials or articles normally available on the open market.

JJ. Seismic Safety Requirements
42 U.S.C. 7701 et seq. 49 CFR Part 41

The contractor agrees that any new building or addition to an existing building will be designed and constructed in accordance with the standards for Seismic Safety required in Department of Transportation Seismic Safety Regulations 49 CFR Part 41 and will certify to compliance to the extent required by the regulation. The contractor also agrees to ensure that all work performed under this contract including work performed by a subcontractor is in compliance with the standards required by the Seismic Safety Regulations and the certification of compliance issued on the project.

KK. Energy Conservation Requirements
42 U.S.C. 6321 et seq. 49 CFR Part 18

The contractor agrees to comply with mandatory standards and policies relating to energy efficiency, which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

LL. Clean Air
42 U.S.C. 7401 et Seq 40 CFR 15.61 49 CFR Part 18

- 1 The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et Seq . The Contractor agrees to report each violation to the Purchaser and understands and agrees that the Purchaser will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.
2. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

MM. Clean Water

- 1 The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et Seq . The Contractor agrees to report each violation to the Purchaser and understands and agrees that the Purchaser will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

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2 The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

NN. Recovered Materials

The contractor agrees to comply with all the requirements of Section 6002 of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6962), including but not limited to the regulatory provisions of 40 CFR Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 CFR Part 247.

OO. Fly America Requirements

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and subrecipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

PP. National Intelligent Transportation Systems Architecture and Standards

The Contractor agrees to conform, to the extent applicable, to the National Intelligent Transportation Systems (ITS) Architecture and Standards as required by section 5206(e) of TEA-21, 23 U.S.C. § 502 note, and comply with FTA Notice, "FTA National ITS Architecture Policy on Transit Projects" 66 Fed. Reg. 1455 *et seq.*, January 8, 2001, and other Federal requirements that may be issued

QQ. Federal Changes

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Agreement (Form FTA MA (9) dated October, 2002) between Purchaser and FTA , as they may be amended or promulgated from time to time during the term of this contract. Contractor's failure to so comply shall constitute a material breach of this contract.

RR. Incorporation of Federal Transit Administration (FTA) Terms

The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1F, dated November 1, 2008 are hereby incorporated by reference. Anything to the contrary herein

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notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any (name of grantee) requests, which would cause (name of grantee) to be in violation of the FTA terms and conditions.

SS. Force Majeure

Neither Party shall be liable to the other Party for failure of or delay in performance of any obligation under this Agreement, directly or indirectly, owing to war, acts of terrorism, acts of God, embargoes, riots, strike and other events beyond its reasonable control, the effect of which, by the exercise of reasonable diligence, the non-performing party could not avoid. In the event that such failure or delay occurs, the affected Party shall notify the other Party of the occurrence thereof as soon as possible and the Parties shall discuss the best way to resolve the event of force majeure.

Neither party shall, however, be excused from performance if nonperformance is due to forces which are preventable, removable, or remediable and which the non-performing party could have, with the exercise of reasonable diligence, prevented, removed, or remedied with reasonable dispatch. The non-performing party shall within a reasonable time of being prevented or delayed from performance by an uncontrollable force, give written notice to the other party describing the circumstances and uncontrollable forces preventing continued performance of the obligations of this Agreement. “

TT. Governing Law

The Contract shall be interpreted under and its performance governed by the laws of the State of Rhode Island.”

UU. Indemnification

Bidders shall indemnify and hold harmless, the State of Rhode Island, all departments and division thereof and the Rhode Island Public Transit Authority from all liability, and said indemnification shall cover and include any and all aspects of liability arising from any lawsuit pertaining to the execution of this contract.

VV. Policy Concerning Federal and Stated False Claim Laws

As required by 42 U.S.C. §1396a(a)(68), the Rhode Island Public Transit Authority (“RIPTA”) publishes the following information to all employees, contractors and agents about federal and state False Claims laws and RIPTA’s policies to detect and prevent fraud, waste and abuse.

1. Prohibitions Against False Claims
Federal False Claims Act

The federal False Claims Act, among other things, applies to the submission of claims for payment by Medicare, Medicaid and other federal and state programs. The False Claims Act is the federal government’s primary civil remedy for improper or

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fraudulent claims. It applies to all federal programs, including welfare and health care benefits.

2. Prohibitions of the Federal False Claims Act

The False Claims Act prohibits, among other things:

- a knowingly presenting or causing to be presented to the federal government a false or fraudulent claim for payment or approval;
- b knowingly making or using, or causing to be made or used, a false record or statement in order to have a false or fraudulent claim paid or approved by the government;
- c conspiring to defraud the government by getting a false or fraudulent claim allowed or paid; and
- d knowingly making or using, or causing to be made or used, a false record or statement to conceal, avoid, or decrease an obligation to pay or transmit money or property to the government.

“Knowingly” means that a person, with respect to information: (1) has actual knowledge of the information; (2) acts in deliberate ignorance of the truth or falsity of the information; or (3) acts in reckless disregard of the truth or falsity of the information, and no proof of specific intent to defraud is required.

3. Enforcement

The United States Attorney General may bring civil actions for violations of the False Claims Act. As with most other civil actions, the government must establish its case by presenting only a preponderance of the evidence rather than by meeting the higher burden of proof that applies in criminal cases.

The False Claims Act allows private individuals to bring “qui tam” actions for violations of the Act.

WW. American with Disabilities Act

All products, equipment or construction provided in accordance with this contract shall comply with the current version of the Americans with Disabilities Act of 1990 - 42 U.S.C. 12101, et seq. at the time of the solicitation.

XX. Expense Reimbursement Professional Services Contracts

The following methods of Reimbursement of Expenses directly related to the performance of this contract shall be utilized. Any expenses incurred must be approved in writing by the RIPTA Project Manager before they occur. The vendor is responsible to submit sufficient documentation to allow the Authority to verify the expenses.

1. Automobile mileage

Travel mileage will be reimbursed at the rate approved by the Internal Revenue Service at the time the travel is incurred.

2. Per Diem Expenses

Meals will be reimbursed at the rates established by the General Services administration for the City of Providence or Newport, which is applicable to the RIPTA Project. The applicable Per

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Diem rates can be found at the following website: www.gsa.gov

A copy of the print out of the GSA website documenting the applicable per diem rate must be attached to the invoice.

3. Lodging

Lodging will be reimbursed at the rates established by the General Services administration for the City of Providence or Newport, which is applicable to the RIPTA Project. The applicable Per Diem rates can be found at the following website:

www.gsa.gov .

A copy of the print out of the GSA website documenting the applicable per diem rate must be attached to the invoice

4. Miscellaneous Expenses

Materials used in conjunctions with this contract shall be provided at cost plus the following (applicable) fee for Overhead, Pickup and Delivery. No additional charges will be acceptable

<u>Material Cost</u>	<u>Overhead Fee</u>
\$0-500	No Fee
\$501-750	\$75.00
\$751-1000	\$100.00
\$1001-1500	\$125.00
\$1501-\$2500	\$180.00
\$2501-5000	\$300.00
\$5001-7500	\$450.00
Over 7501.	\$525.00

Copies of Receipts must be submitted to verify Miscellaneous Expenses

5. Estimated Expenses

Bidders are required to submit an accurate list of projected expenses that may be necessary to properly execute the Scope of Services of this Contract. This must be submitted with the Bid submittal.

YY. Background Check

Employees of the Successful Vendor that in the course of performance of this contract will be on any of RIPTA's Properties may be subject to a Criminal Background Check.

ZZ. Security Requirements for Work on RIPTA Property

1. Upon arrive at the RIPTA work location they are to sign in with the Mechanical Foreman (or designated person) on duty
2. Wear all the proper safety equipment as required.
3. Display RIPTA issued vendor badge so it can be observed on their person.
4. Access only areas where permission has been granted.
5. Sign out with the same Foreman they signed in with.
6. Secure the facility prior to the facility being locked up.
7. Any issued or non-compliance with these rules could result in their access to the property being denied.

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AAA. Records Retention

All required records for this contract will be retained for a minimum of three years after grantees or sub grantees make final payments and all other pending matters are closed.

BBB. Litigation

In the last ten (10) years has any customer to which you provide the same or similar services that are the subject of this procurement initiated a lawsuit or arbitration against you relating to your provision of the services?

If so, provide a copy of the complaint against you and advise as to the status of the proceeding. If the case has been resolved, please describe the resolution of the case.

CCC. Public Records/Confidentiality

The Bids received become the exclusive property of RIPTA. When a contract award is approved by RIPTA, all Bids submitted in response to this Invitation for Bids shall become a matter of public record and shall be regarded as public records, with the exception of those elements of each Bid that are marked as "CONFIDENTIAL" or "PROPRIETARY". If required by law or by an order of a court, RIPTA may be required to disclose such records or portions thereof, including without limitation those so marked

DDD. Utilization of Small Business Sub-Contractors

It is suggested that Prime Contractors provide subcontracting opportunities that small business, including DBE's can reasonably perform rather than self-performing all of the work in the contract.

EEE. Federal, State and Local Safety, Health and Environmental Regulations.

It shall be the responsibility of the Contractor to follow all relevant Safety and Health Regulations. The Contractor shall be responsible to determine which regulations shall apply and they shall follow them. The Authority may include specific RIPTA policies, in the Technical Specifications, which must be followed.

FFF. Licenses and Certifications

The Contractor shall be responsible to insure their company and any and all Subcontractors possible the necessary licenses and certifications to perform the work as required by the State of Rhode Island and the Authorities having Jurisdiction.

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VIII. REQUEST FOR APPROVED EQUAL FORM

**This form must be submitted electronically IN MICROSOFT WORD
FORMAT TO RIPTA CONTRACTS MANAGER**

REQUEST FOR APPROVAL EQUAL QUALIFICATION OR CLARIFICATION

Page: _____

Ref: IFB NO. 20-05

Project No. _____

To: Rhode Island Public Transit Authority

From: _____

Page & Reference: _____

Request Description

Use Additional Sheet If More Space Is Required

Accepted: _____

Rejected: _____

See Addendum # _____

Explanation: _____

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IX. REQUIRED BID SUBMISSIONS

The following items marked with an "X" must be submitted with Response
Failure to submit forms may result in Bid being deemed non-responsive

Please submit them in the correct order by Page Number.

Required Company Information Form (found third pg of pkg)	<u> X </u>
<u>Must be completed by Prime and All Subcontractors</u>	
Solicitation	<u> X </u>
Offer	<u> X </u>
Statement of Eligibility	<u> X </u>
Affidavit of Non-Collusion	<u> X </u>
Certification of Restrictions on Lobbying	<u> X </u>
Buy America Certificate FORM MUST BE SUBMITTED WITH BID, IF CHECKED, OR BID WILL BE CONSIDERED NON RESPONSIVE	<u> X </u>
Disadvantaged Business Enterprise	<u> </u>
General Contract Compliance Certificate Agreement (EEO)	<u> X </u>
Certification of Primary Participant Debarment	<u> X </u>
Certification of a Subcontractor (Debarment)	<u> X </u>
Each Subcontractor and potential subcontractor must fill in and sign	
Non-Resident Contractor (if applicable)	<u> X </u>
<u>Davis Bacon Act Compliance</u>	<u> X </u>
Applicable Type: (X)Building () Highway	
Wage Determination Number: <u>RI20200001 1/24/2020 MOD 1</u>	
Drug & Alcohol Testing	<u> </u>
Bid Guarantee (Surety)	<u> X </u>
Designation of an Independent Contractor Form	<u> X </u>
IRS W-9 Form (Copy Attached)	<u> X </u>

The following items marked with an "X" must be submitted AFTER AWARD of the Contract

Performance and Payment Bonds	<u> X </u>
Certificate of Insurance- (as required in Section XX and the Technical Specifications)	<u> X </u>

NOTE:
ITEMS WITHOUT AN "X" AND THEIR RESPECTIVE TERMS AND CONDITIONS ARE NOT REQUIRED IN THIS BID

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X. SOLICITATION FORM

COMPANY NAME _____

BID NO. OR PROJECT NO. 20-05

DESCRIPTION Chaffee Building Rehabilitation

A. BID REQUIREMENTS

Sealed Bids in original and Two copy (ies) will be received at the offices of the Rhode Island Public Transit Authority, 705 Elmwood Avenue Providence, Rhode Island 02907, at the Bid date and hour set forth on the Invitation for Bids or anytime prior to the date and hour. Late Bids will not be accepted.

B. CONTRACT DOCUMENTS

By executing the offer form enclosed herewith, the Bidder agrees to provide all services set forth on the specifications attached hereto upon the terms and conditions set forth in paragraphs A, B, C and D.

C. PAYMENT SCHEDULE

Payment will not be made until receipt and installation of merchandise is accepted by the Transit Authority.

D. COST FOR SERVICE

Please complete necessary cost information as outlined in the Bid Technical Specifications.

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XI. OFFER FORM

Bidder understands that any condition other than stated in the specifications, clarification made to the above, or information submitted on or with this form, other than that requested, may render the Bid non-responsive.

By execution below, Bidder hereby offers to furnish services in accordance with the contract documents that are a part of the specifications, and agrees to fully comply with the contract documents.

BID NO 20-05

BIDDER _____

EMPLOYER IDENTIFICATION NO. _____

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

TYPE OF BUSINESS ENTITY: (Please check one)

Sole Proprietor _____

Partnership _____

Corporation _____

BIDDER'S CONTRACTING OFFICER

Name (*Please Print*)

Authorized Signature

Title

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XII. STATEMENT OF ELIGIBILITY FORM

The _____ hereby certifies that he/she
(Name of Bidder)

is/is not (underscore one) included on the Comptroller General's Lists of Persons or Firms Currently Barred for Violations of Various Public Contracts Incorporating Labor Standards Provisions.

Name of Firm

Address

City, State, Zip

Signature of Authorized Person

Date Authorized

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XIII. AFFIDAVIT OF NON-COLLUSION FORM

I hereby swear (or affirm) under penalty for perjury:

1. that I am the Bidder (if the Bidder is an individual), a partner of the Bidder (if the Bidder is partnership), or an officer or employee of the proposing corporation having authority to sign on its behalf (if the Bidder is a corporation).
2. that the attached Bid has been arrived at by the Bidder independently, and has been submitted without collusion with, and without agreement, understanding, or planned common course of action with, any other vendor of materials, supplies, equipment, services described in Invitation for Bids, designed to limit independent Bidding or competition.
3. that the contents of the Bid has not been communicated by the Bidder or its employees or agents, to any person not an employee or agent of the Bidder or its surety on any bond furnished with the Bid, and will not be communicated to any such person prior to the official opening of the Bid; and
4. that I have fully informed myself regarding the accuracy of the statement made on this affidavit.

Name

Address

City, State, Zip

Signature of Authorized Official

Date Authorized

Subscribed and sworn before me this _____ day of _____, 20____

Notary Public

My commission expires _____

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XIV. CERTIFICATION OF RESTRICTIONS ON LOBBYING FORM

I, _____, hereby certify on
(Name/title of Bidder Authorized Official)

behalf of: _____ that:
(Name of Bidder)

- 1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, grant, loan, or cooperative agreement.
- 2) If any funds other than Federal appropriated funds have been paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, or an employee of a member of Congress in connection with this Federal contract, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying", in accordance with its instructions.
- 3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclosure accordingly.

This certification is a material representation of fact upon which reliance is placed when this transaction was made or entered into. Submission of the certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Executed this _____ day of _____, 20_____.

By _____
(Signature of Authorized Official)

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XV. BUY AMERICA CERTIFICATION REQUIREMENTS !
FOR PROCUREMENT OF STEEL OR MANUFACTURED PRODUCTS

49 U.S.C. 5323(j) and 49 CFR 661.6 provide that no Federal funds may not be obligated for mass transportation projects unless steel and manufactured products used in these projects are produced in the United States.

If steel or manufactured products are being procured, the appropriate certificate as set forth below shall be completed and submitted by each Bidder.

Certificate of Compliance-The Bidder hereby certifies that it will comply with the requirements of 49 U.S.C. 5323 (j)(1) and the Applicable regulations on 49 CFR Part 661.12

COMPANY NAME _____

SIGNATURE _____

TITLE _____

DATE _____

Certification of Non-Compliance-The Bidder hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323 (j)(1).

COMPANY NAME _____

SIGNATURE _____

TITLE _____

DATE _____

FORM MUST BE SIGNED AND SUBMITTED WITH BID OR BID WILL BE CONSIDERED TO BE NON-RESPONSIVE.

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XVI. BUY AMERICA CERTIFICATION REQUIREMENTS II **OF PROCUREMENT OF BUSES, OTHER ROLLING STOCK AND** **ASSOCIATED EQUIPMENT**

49 U.S.C. 5323 (j) and 49 CFR 661.11 and 12 provide that no Federal funds be obligated for procurement of buses, other rolling stock and associated equipment unless the following conditions are met:

1. The cost of components which are produced in the United States is more than 60 per centum (65%) of the cost of all components of the vehicle or equipment described in this paragraph; and
2. Final assembly of the vehicle or equipment described in this paragraph has taken place in the United States.

If buses or other rolling stock (including train control, communication and traction power equipment) are being procured, the appropriate certificate as set forth below shall be completed and submitted by each Bidder in accordance with the requirements.

Certificate of Compliance-The Bidder hereby certifies that it **will comply** with the requirements of the 49 U.S.C. 5323 (j)(2)(c) and CFR Part 661.

COMPANY NAME _____

SIGNATURE _____

TITLE _____

DATE _____

Certificate of non-Compliance-The Bidder hereby certifies that it **cannot comply** with the requirements of the Surface Transportation Assistance Act of 1982, as amended, but may qualify for an exception to the requirements.

COMPANY NAME _____

SIGNATURE _____

TITLE _____

DATE _____

FORM MUST BE SIGNED AND SUBMITTED WITH BID OR BID WILL BE
CONSIDERED TO BE NON-RESPONSIVE.

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XVII. BUY AMERICA PRE-AWARD AND POST-DELIVERY AUDITS:

A. Prior to Contract award,

The apparent successful offeror shall provide to the Authority's auditors the cost of the components and subcomponents to be used in the manufacturing of the rolling stock, their country of origin, the location of final assembly, the activities that will take place at the location and pertinent supporting documentation for the purpose of RIPTA performing the cited Pre-Award Audit of Buy-America requirements.

B. After delivery and acceptance of the vehicles,

The Contractor shall provide to the Authority's auditors the cost of the components and subcomponents used in the manufacture of the rolling stock, their country of origin, the location of final assembly, the activities that took place at the location and pertinent supporting documentation to enable RIPTA to perform the cited Post-Delivery Audit of Buy America Requirements.

C. Authority Review

The contractor shall facilitate the reviews by the Authority's auditors by providing the supporting documentation for the above information in a timely fashion.

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XVIII. DISADVANTAGED BUSINESS ENTERPRISES PROGRAM

For the purpose of this Contract, the goal for utilization of DBEs shall be the following percent of the Contract Dollar Amount:

DBE GOAL FOR THIS CONTRACT: Not Applicable Percent

A. Policy

1. It is the policy of the DOT that Disadvantaged Business Entities are given the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal funds, pursuant to 49 CFR Part 26. Consequently, the DBE requirements of 49 CFR Part 26, as amended, apply to this Contract and RIPTA and its Contractors shall take all necessary and reasonable steps to ensure that DBE's have the maximum opportunity to compete for such contracts. RIPTA and its Contractors shall not discriminate on the basis of race, color, religion, national origin, age sexual orientation, disability, gender identity, expression, or veteran status, in the award and performance of DOT-assisted contracts.

2. Contractor Obligation –

a. In the event that a DBE Utilization Goal is set on this Contract, Contractors and subcontractors failing to carry out applicable requirements of 49 CFR Part 26 and/or uses or attempts to use false, fraudulent or deceitful statements/representations or otherwise exhibits a serious lack of business integrity or honesty to meet such DBE Utilization Goal, shall be in breach of contract. After notification to the DOT, RIPTA may terminate the Contract or take any other action it deems appropriate. The DOT may take joint or separate action, as it deems appropriate and necessary.

b. The Contractor shall provide the following assurance and ensure that each subcontract that it enters with a subcontractor contains the same assurance:

The Contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, religion, age, national origin, sexual orientation, disability, gender identity, expression, or veteran status in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient, deems appropriate, which may include, but is not limited to:

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- (1). Withholding monthly progress payments;
 - (2). Assessing sanctions;
 - (3). Liquidated damages; and/or
 - (4). Disqualifying the Contractor from future bidding as non-responsible
2. Contractor Obligation – In the event that a DBE Utilization Goal is set on this Contract, Contractors and subcontractors failing to carry out applicable requirements of 49 CFR Part 26 and/or uses or attempts to use false, fraudulent or deceitful statements/representations or otherwise exhibits a serious lack of business integrity or honesty to meet such DBE Utilization Goal, shall be in breach of contract. After notification to the DOT, RIPTA may terminate the Contract or take any other action it deems appropriate. The DOT may take joint or separate action, as it deems appropriate and necessary.
3. DBE Utilization - The Contractor shall provide for full and fair utilization of DBEs by complying with the requirements of this Section. Such requirements include the achievement of the stated DBE Utilization Goal in the performance and completion of the work under the Contract. Nothing in this Section shall be construed to require the utilization of any DBEs, which is either not qualified or unavailable.
- a. **All DBEs submitted must be certified by the State of Rhode Island at the time of Bid submittal. A copy of the DBE Certification Letter from the State of Rhode Island Office of Civil Rights must accompany the Bid submittal**
 - b. **If a DBE Utilization Goal is set for this Contract, a Contractor’s DBE utilization and/or “Good Faith Effort” to obtain DBE participation shall be considered when reviewing bid submittals for responsiveness.**
 - c. **If NO DBE Utilization Goal is set for this Contract, Contractors are, nonetheless, encouraged to have DBE/Small Business participation in their bid and to include the associated DBE forms in its bid submittal.**

B. Definitions.

The terms used in these special provisions shall be defined as follows:

1. Joint Venture

An association of two or more persons to carry out a single business enterprise for profit, for which purpose they combine their property, money, efforts, skills and knowledge.

2. Disadvantaged Business

means a small business concern in which is, at least, 51 percent owned by one or more socially and economically disadvantaged individuals, or, in the case of any publicly owned business, at

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least 51 percent of the stock of which is owned by one or more socially and economically, disadvantaged individuals who own it.

3. **Small Business Concern**

A small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto.

4. **Socially and Economically Disadvantaged Individuals**

means those individuals who are citizens of the United States (or lawfully admitted permanent residents) and who are women, Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, or Asian-Indian Americans and any other minorities of individuals found to be disadvantaged by the Small Business Administration pursuant to Section 8 (a) of the Small Business Act, RIPTA shall make a rebuttal presumption the individuals in the following groups are socially and economically disadvantaged. RIPTA may also determine, on a case-by-case basis, that individuals who are not a member of one of the following groups are socially and economically disadvantaged:

- a. **Black or African Americans**, which includes persons having origins in any of the Black racial groups of Africa;
- b. **Hispanic or Latino Americans**, which includes persons of Mexican, Puerto Rican, Cuban, Central or South America, or other Spanish culture or Portuguese culture, regardless of race;
- c. **American Indian or Alaska Native**, which includes persons who are American Indian, Eskimo or Aleuts;
- d. **Asian-Pacific Americans or Native Hawaiian**, which includes persons whose origins are Hawaii, Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, and the Northern Marianas; and
- e. **Asian-Indian Americans**, which includes persons whose origins, are from India, Pakistan, and Bangladesh.
- f. **Disadvantaged Business Enterprise (DBE) Liaison Officer** – the individual designated by the Authority to monitor compliance with these Special Provisions and to assist in their implementation.
- g. **Bidder** – any individual, partnership, joint venture, corporation or firm submitting a Bid for the contract.

C. Recognition of DBE Commitment

Each Contractor shall recognize RIPTA's commitment to insure that DBEs be afforded full opportunity to participate in contracts awarded by RIPTA and will not be discriminated against on the grounds of race, color, religion, age, national origin, sexual orientation, disability, gender identity or expression or veteran status.

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D. Bid Submissions for Contracts with DBE Utilization Goals and/or DBE Participation

The Schedule of DBE Participation (Attachment A) shall have the following information

1. The name and address of each DBE firm that will participate in the Contract;
2. A description of the work each named DBE firm will perform; and
3. The dollar amount and percentage of the DBE Utilization Goal, if applicable, of participation by each named DBE firm.
4. RIPTA encourages all firms located in the United States that are currently certified as DBEs and SBAs by Federal, State and Local agencies to apply for certification in the State of Rhode Island. **Only DBEs certified by the State of Rhode Island at the time of Bid submittal shall be counted towards any DBE Utilization Goal requirement.**

If a minority business would like to be certified by the State of Rhode Island, contact the Minority Business Enterprise Compliance Program:

Ms. Dorinda Keene, Assistant Administrator – MBE Compliance
RI Department of Administration
Office of Diversity, Equity and Opportunity
Minority Business Enterprise Compliance Program
One Capitol Hill, 3rd Floor
Providence, RI 02908
401.574.8670

E. Good Faith Efforts for DBE Participation:

If the apparent successful Contractors' submissions does not satisfy the goal, RIPTA shall determine whether the apparent successful competitor has made good faith efforts to obtain DBE participation in accordance with the guidelines stated in Paragraph F, Sub-paragraph 1, below.

Unsuccessful efforts in gaining DBE participation must be documented on the "DBE Unavailability Certification" attached hereto as Attachment D. Meeting the DBE contract goals or making good faith efforts to meet the goals is a condition of receiving a Federal Transit Administration assisted contract for which contract goals have been established by RIPTA.

The legitimacy of each DBE or disadvantaged-majority joint venture shall be determined by RIPTA, based on the information submitted in the affidavits attached hereto as Attachments C and D. RIPTA will require all prime contractors to make good faith efforts to replace a DBE subcontractor that is unable to perform successfully with another DBE. RIPTA shall approve all substitutions of subcontractors **before** award of

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contract and **during** contract performance, in order that substitute firms are eligible DBE's.

F. Procedure Prior to Contract Award

1. Guidance Concerning Good Faith Efforts to Meet DBE Contract Goals.

RIPTA may decide that a Contractor that has failed to meet DBE contract goals may receive the Contract upon determining that the efforts the Contractor made to obtain DBE participation were "good faith efforts" to meet the goal. RIPTA shall not consider efforts that are merely pro forma to be good faith efforts to meet the goals, even if they are sincerely motivated, if, given all relevant circumstances, they could not reasonably be expected to produce a level of DBE participation sufficient to meet the goals. In order to award a contract to a Contractor that has failed to meet DBE contract goals, RIPTA must determine that the competitor's efforts were those that, given all relevant circumstances, a competitor, actively and aggressively seeking to meet the goals would make.

Following is a list of the kinds of efforts RIPTA may consider. The list is not exclusive or exhaustive and in appropriate cases, RIPTA shall consider other relevant factors or types of efforts. RIPTA shall consider not only the different kinds of efforts the contractor has made, but also the quantity and intensity of those efforts. All information must be in writing and copies of all ads, written notices, follow-up letters and/or all other correspondence must be presented whenever a waiver is asked for.

RIPTA will consider the following efforts:

- i. whether the contractor attended any pre-solicitation or pre-Bid meetings that were scheduled by RIPTA to inform DBEs of contracting opportunities;
- ii. whether the contractor advertised in general circulation, trade association, and disadvantaged focus media concerning the sub-contracting opportunities;
- iii. whether the contractor provided written notice to a reasonable number of specific DBEs that their interest in the contract was being solicited in sufficient time to allow the DBEs to participate effectively;
- iv. whether the contractor followed up initial solicitation of interest by contracting DBEs to determine with certainty whether the DBEs were interested;
- v. whether the contractor selected portions of the work to be performed by DBEs in order to increase the likelihood of meeting the DBE goals including, where appropriate, breaking down contracts into economically feasible units to facilitate DBE participation;

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- vi. whether the contractor provided interested DBEs with adequate information about the plans, specifications and requirements of the contract;
- vii. whether the contractor negotiated in good faith with interested DBEs, not rejecting DBEs as unqualified without sound reasons based on a thorough investigation of their capabilities;
- viii. whether the contractor made efforts to assist interested DBEs in obtaining bonding lines of credit, or insurance required by RIPTA or contractor; and
- ix. Whether the contractor effectively used the services of available disadvantaged community organizations, disadvantaged contractor's groups, Local, State and Federal disadvantaged business assistance offices, and other organizations that provide assistance in the recruitment and place of DBEs.

G. Termination of DBE Subcontractors

In any case when a prime contractor wishes to either: A: decrease the price to be paid to the DBE and the disadvantaged non-disadvantaged joint venture or to B: terminate a DBE firm, the prime contractor must first provide the DBE with five day's notice of the prime contractor's intent and reason to terminate the contract between them, and must also advise the DBE firm that it has the right to contact RIPTA to object to the termination. In addition, after the five day written notice to the DBE has expired, the prime contractor must provide RIPTA with a written request to approve termination. The request must state the business reason why the prime contractor wishes to terminate the contract, and must include all documentation in support of that business reason. A prime contractor may only reduce the scope or terminate a DBE firm for cause. It may not terminate a DBE contract for convenience. A DBE firm may not be terminated until written approval has been provided by RIPTA. If RIPTA approves a request to terminate, the prime contractor must make a good faith effort to substitute another DBE firm to replace the firm that has been terminated. This good faith effort shall be documented and subject to review by RIPTA. Failure to make a good faith effort may be deemed a breach of the prime contractor's contract with RIPTA, and may result in the prime contractor being barred from bidding on future RIPTA projects or subject to any other remedy RIPTA deems appropriate.

H. Substitution of Subcontractors

RIPTA shall review for its approval all substitutions of subcontractors in order to determine if the percentage goal will be decreased by substitution of a disadvantaged contract/supplier with a non-disadvantaged contractor/supplier.

Where RIPTA has approved termination of a sub-contract held by an DBE or disadvantaged non-disadvantaged joint venture, the successful Bidder shall make every reasonable effort to propose and enter into an alternative sub-contract or subcontracts for the same work to be

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performed by another qualified DBE for a contract price or prices totaling not less than the contract price of the terminated sub-contract. Satisfactory evidence of reasonable efforts shall be timely furnished by RIPTA.

I. **Program Compliance**

Discrimination on the basis of race, color, religion, age, national origin, sexual orientation, disability, gender identity or expression or veteran status shall not be tolerated under any circumstance. RIPTA shall monitor the schedule for DBE participation in an effort to isolate those prime contractors who do not adhere to the non-discriminatory policies of RIPTA. If such contractor fails to respond to counseling with respect to the disposition of subcontracts pertaining to RIPTA funds, RIPTA reserves the right to terminate the contract and to consider future Bids of such contractor to be non-responsive in the absence of written assurance from it of the full opportunity for DBEs to participate in its awards of subcontracts, together with the follow-up to verify such participation.

J. **Maintenance of Records**

All records relating to the contract shall be maintained by the contractor for a period of three (3) years after project completion.

K. **Prompt Payment**

The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than 30 days from the receipt of each payment the prime contractor receives from RIPTA. The prime contractor agrees further to return retainage payments to each subcontractor within 30 days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above reference period may occur only for good cause following written approval of RIPTA. This clause applies to both DBE and non-DBE subcontractors. RIPTA reserves the right to hold payments to the Contractor if payments verification logs are not submitted within 30 days of payments. Failure to submit payments to DBE subcontractors within 30 days will result in action by RIPTA up to and including disqualification from any future RIPTA Procurements.

L. **Monitoring Payments to DBEs**

RIPTA requires that prime contractors to maintain records and documents of payments to DBEs following the completion of the contract. These records will be made available for inspection upon request by any authorized representative of RIPTA or United States Department of Transportation. This requirement also extends to any DBE Subcontractor. Reports of payments to DBE Subcontractors shall be provided to the RIPTA DBE Liaison Officer on a monthly basis. Failure to submit these reports on a timely basis may result in delay of payments.

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XIX. DISADVANTAGED BUSINESS ENTERPRISE REQUIRED FORMS

Attachment A: Schedule of DBE Participation

Submitted if DBE firm or firms will be participating in the Bid.

Attachment B: DBE Application Agreement

Submitted if DBE firm or firms will be participating in the Bid.

Attachment C: Letter of Intent to Perform as a Subcontractor

Submitted if DBE firm or firms will be participating in the Bid

Attachment D: DBE Unavailability Summary Sheet

Submitted if DBE firm or firms you have contacted cannot participate. This form is used to document good faith effort. This form only needs to be completed when there is a DBE Participation Goal.

Attachment E: Narrative Explanation for Lack of DBE Participation

Submitted by the Prime Contractor to explain lack of DBE/SBA participation.

Attachment F: Documentation of DBE Utilization

To be filled in by the DBE firm and the prime contractor once the DBE Subcontractor has been paid.

Please Note: Final payment to the Prime Contractor will be held until this form or forms are received for each DBE Subcontractor.

DBE FIRMS PROPOSING AS A PRIME CONTRACTOR: the following forms must be filled in, signed and submitted with the Bid

Attachment A, Attachment B

Please state, on these forms, that you are proposing as a prime contractor.

CERTIFICATION LETTER OR NOTIFICATION MUST BE INCLUDED FOR EACH DBE FROM THE STATE OF RHODE ISLAND.

Please record by letter (using the list below) under the DBE Category Column found on Attachment A: Schedule of DBE Participation Form on the following page

- a. "Black Americans", which includes persons having origins in any of the Black racial groups of Africa;
- b. "Hispanic Americans", which includes persons of Mexicans, Puerto Rican, Cuban, Central or South America, or other Spanish culture or Portuguese or origin, regardless of race;
- c. "Native Americans", which include persons who are American Indian, Eskimos, Aleuts, or Native Hawaiians;
- d. "Asia-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, and the Northern Marianas;
- e. "Asian-Indian Americans", which includes persons whose origins are from India, Pakistan, and Bangladesh; and
- f. Any other minorities or individuals found to be disadvantaged by the Small Business Administration pursuant to Section 8 (a) of the Small Business Act.

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SCHEDULE OF DBE PARTICIPATION

A. Attachment A

Company Name: _____

Project Number: 20-05 Project: Chaffee Building Rehabilitation

*Please provide copy of DBE Certification Letter for each DBE firm listed from the Rhode Island Office of Civil Rights. **DBE Vendors must be certified in the State of Rhode Island at the time of Bid Submittal to be considered. A full, up to date list of Rhode Island DBEs can be obtained at the following website: www.mbe.ri.gov/**

DBE Firm Name	DBE Firm Address	DBE Category	Phone Number	Contact Name	Work to be Performed	Estimated Value Dollars	Estimated Value Percent of Bid

The undersigned will enter into a formal agreement with Disadvantaged Business Enterprise firms for work listed in this schedule conditioned upon execution of a contract with the Rhode Island Public Transit Authority.

Authorized Signature of Bidder Official _____

Each DBE Firm listed in the Section must also complete the Required Company Information Form and the Certification of Subcontractor Form Use additional forms as needed.

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DBE APPLICATION AGREEMENT

B. Attachment B

Project Number: 20-05

Project Name: Chaffee Building Rehabilitation

With respect to the above numbered project, I hereby certify that I am the _____ and duly authorized representative of _____

(Title) (Firm)
Address is _____, _____, _____

(Street) (State) (Zip Code)

I do hereby certify that it is the intention of the above organization to affirmatively seek out and consider Disadvantaged Business Enterprises to participate in this contract as contractors, Subcontractors and/or suppliers of requirements of the U.S. Department of Transportation's regulation 49 CFR Part 26.

I understand and agree that any and all contracting in connection with this contract, whether undertaken prior to or subsequently to award of contract, will be in accordance with this provision.

The utilization of Disadvantaged Business Enterprise is in addition to all other equal opportunity requirements of this contract.

Authorized Signature

Title

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LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR

C. Attachment C

To: _____
(Name of Prime or General Bidder)

The undersigned intends to perform work in connection with the above project as (check one):

___ an individual

___ a corporation

___ a partnership

___ a joint venture

The undersigned is prepared to perform the following described work in connection with the above project (specify in detail particular work items or parts thereof to be performed).

for the following compensation: _____

(Name of DBE Contractor)

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DBE GOOD FAITH EFFORT SUMMARY SHEET

D. Attachment D.

RIPTA requires a listing of DBE firms contacted; but not able to perform work. Use additional pages as needed. The DBE Goal for this project is Not Applicable percent. . **A full, up to date list of Rhode Island DBEs can be obtained at the following website: www.mbe.ri.gov/**

DBE Firm Name	DBE Firm Address	DBE Category	Phone Number Email Address	Contact Name	Reason Unable to Perform Work

Project Name: Chaffee Building Rehabilitation

Project Number: 20-05

Form completed by: _____

Date: _____

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NARRATIVE EXPLANATION FOR LACK OF DBE PARTICIPATION
E. Attachment E

Company Name: _____

Project Number: 20-05

Project Name: Chaffee Building Rehabilitation

(Authorized Signature of Prime Contractor)

**TO BE FILLED IN BY THE PRIME CONTRACTOR TO EXPLAIN LACK OF
DBE PARTICIPATION.**

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XX. PERFORMANCE AND PAYMENT BOND INFORMATION

The selected Bidder shall furnish, within twenty (20) calendar days (if required) after the date of notice of award of contract by RIPTA, Performance and Payment Bonds in the amount of 100% of the Bid amount covering the faithful performance of the contract.

The Performance Bond is to be secured through an insurance company or companies which is licensed in the State of Rhode Island or which is approved by the Authority.

The Bond will remain in effect until the Warranty commences.

XXI. BID GUARANTEE (SURETY)

A Bid Guarantee (if required) shall be submitted with the Bid response. This guarantee shall be equivalent to five (5) percent of the Bid price. The "Bid guaranty shall consist of a firm commitment such a Bid bond, certified check, or other negotiable instrument accompanying a Bid as assurance that the Bidder will, upon will, upon acceptance of its Bidder, execute such contractual documents as may be required within twenty (20) calendar days after the date of notice of award of contract by RIPTA.

XXII. REQUIRED INSURANCE

The Bidder will be required to secure and maintain the following insurance coverages:

A. Minimum limits

1. Commercial comprehensive general liability insurance, with limits of \$3,000,000.00 per accident and \$5,000,000.00 aggregate.
1. Workers' Compensation Coverage in accordance with RI Statutory requirements.
2. The Rhode Island Public Transit Authority shall be named as additional insured under said policies.
3. Automotive Liability Insurance
 - \$1,000,000.00 per accident and \$3,000,000.00 aggregate: bodily injury.
 - \$1,000,000.00 property damage
4. All insurance coverage must provided under an occurrence policy. Claims made policies are not acceptable.

B. Certificate Requirements

1. Each Bidder must provide RIPTA a Certificate of Insurance upon award of the contract. Coverage indicated on certificate must be kept in effect at all times during the contract period
1. The General Liability Coverage shall include Contractual Liability and Completed Operations Coverages. The

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General Liability coverage, certificates must name: RIPTA and its respective directors, officers, employees, and affiliates as additional insureds. Reference should be made to project or job number and location.

2. A Waiver of Subrogation in favor of RIPTA must apply to the General Liability, Employers Liability, and Excess Liability / Umbrella policies.
3. Automobile Liability must cover any owned, rented, hired or borrowed vehicles.
4. The Excess or Umbrella coverage must provide the required Liability limit over the General Liability, Automobile Liability, Employers Liability s, Professional Liability and Environmental Liability policies (if required).
5. If Bidder is to use any subcontractor during the course of the project, the subcontractor must maintain the same limits and terms as the Bidder. Certificates of Insurance for subcontractors must be provided to RIPTA with the Bidder's Submittal after award of the Contract.
6. All certificates of insurance must indicate the carrier policy cancellation terms.
7. All bidders must utilize insurance companies with a "Best" Rating of no less than A-, Size VIII.

C. Special Coverages

- 1 Contractor must maintain Environmental Pollution coverage with limits no less than \$1,000,000 if contractors work includes the transport, delivery, storage, handling or disposal of any pollutants or other hazardous materials. This insurance is also required for all contracts involving any work on RIPTA's storage tanks, and fluid distribution systems
- 2 Installation Floater Insurance is required for all construction projects equal to the value of the project.
- 3 Professional Liability/Errors and Omission coverage shall be included in all Professional Services Contracts

Bidder shall provide to RIPTA Contracts Manager a Certificate of Insurance upon award of contract. This Certificate shall be kept in effect at all times. Current copies shall be provided to the Contracts Manager

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XXIII. GENERAL CONTRACT COMPLIANCE CERTIFICATE
AND AGREEMENT

RHODE ISLAND STATE EQUAL OPPORTUNITY OFFICE

The undersigned Contractor agrees and certifies, unless otherwise exempt, that it is in compliance with the applicable requirements of Federal Executive order No. 11246, as amended, Rhode Island General Law 28-5.1-10, and other regulations as issued by the Rhode Island Public Transit Authority, as set forth below, or will take steps to comply with such requirements prior to acceptance of any order from us. This agreement and certificate shall form a part of, and be deemed incorporated in, each order submitted to you for supplies or services exceeding \$10,000. Failure to comply will be considered a substantial breach of the contract.

A. Equal Opportunity Clause

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

1. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or natural origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the non-discrimination clause.
2. The Contractor will, in all solicitations or advertisements for placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
3. The Contractor will send to each labor union or representative of workers with which he/she has collective bargaining agreement or other contract or understanding a notice, advising the labor union or worker's representative of the Contractor's commitments under Section 202 of Federal Executive order No. 11246, as amended, Rhode Island Law 28-5.1-10, and other regulations and relevant orders of the Secretary of Labor.
4. The Contractor will comply with all provisions of Federal Executive Order No. 11246, as amended, Rhode Island

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- General Law 28-5.1-10, and other regulations and relevant orders of the Secretary of Labor.
5. The Contractor will furnish all information and reports required by Executive Order No. 11246, as amended, Rhode Island General Law 28-5.1-10 and other regulations as issued by the State of Rhode Island, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his/her books, records and accounts by the State Equal Opportunity Office and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.
 6. In the event of the Contractor's non-compliance with the non-compliance with the non-discrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated or suspended in whole or part, and the Contractor may be declared ineligible for further State contracts in accordance with procedures authorized in Federal Executive Order No. 11246, as amended, Rhode Island General Law 28-5.1-10 , and other regulations as issued by the State of Rhode Island, and such other sanctions may be imposed and remedies invoked as provided in Federal Executive Order No. 11246, as amended; Rhode Island Public Transit Authority, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law, or the State of Rhode Island and Providence Plantations.
 7. The Contractor will include the provisions of paragraphs (1) through (7) in every sub-contract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Federal Executive Order No. 11246, as amended, Rhode Island General Law 28-5.1-10, and other regulations as issued by the Rhode Island Public Transit Authority, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any sub-contract of purchase order as the contracting agency may direct as a means of enforcing such provisions including sanctions for non-compliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States and the State of Rhode Island to enter into such litigation to protect the interest of the United States and the State of Rhode Island.

B. Age Discrimination

Pursuant to Federal Executive Order No. 11246, as amended, the Contractor will not, in connection with the employment,

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advancement or discharge of employees, or in connection with the terms, conditions, or privileges of their employment, discriminate against persons because of their age except upon the basis of a bona fide occupational qualification, retirement plan or statutory requirement, nor will the Contractor specify, in solicitations or advertisements for employees, a maximum age limit for employment unless the specified maximum age limit is based upon a bona fide occupational qualification, retirement plan or statutory requirement.

C. Employment of the Handicapped

1. Contractor will not discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant for employment is qualified. Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices such as the following employment, upgrading, demotion or transfer, recruitment or recruitment advertising; layoff or termination, rates of selection for training, including apprenticeship.
2. Contractor agrees that if a handicapped individual files a complaint with him/her that he/she is not complying with the requirements of the Rehabilitation Act of 1973, he/she will (1) investigate the complaint and take appropriate action consistent with requirements of 41 CFR Part 60-741.29 and (2) maintain on file for three years, the record regarding the complaint and the actions taken.
3. Contractor agrees that if a handicapped individual files a complaint with the Department of Labor that he/she has not complied with the requirements of the act, (1) he/she will cooperate with the Department in its investigation of the complaint, and (2) he/she will provide all pertinent information regarding his/her employment practices with respect to the handicapped.
4. Contractor agrees to comply with the rules and regulations of Section 503 of the Rehabilitation Act of 1973 as interpreted in 41 CFR Part 60-741.29.
5. In the event of Contractor's noncompliance with the requirements of this clause contract may be terminated or suspended in whole or in part.
6. This clause shall be included in all subcontracts. In the event that this contract exceeds \$10,000 but is less than \$500,000 and provides for performance in 90 days or more, Contractor further agrees as follows:
7. Contractor agrees (1) to establish an affirmative action program, appropriate procedures consistent with the guidelines and the rules of the Secretary of Labor, will

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provide the affirmative action regarding employment and advancement of the handicapped required by P.L. 93-516, (2) to publish the program in the employees or personnel handbook or otherwise distribute a copy to all personnel, (3) to review the program each year and to make such changes as may be appropriate, and (4) to designate one of the principal officials to be responsible for the establishment and operation of the program.

8. Contractor agrees to permit the examination by appropriate contracting agency officials or the Assistant Secretary for Employment Standards or the designee, of pertinent books, documents, papers and records concerning employment and advancement of the handicapped.
9. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Assistant Secretary for Employment Standards, provided by the contracting officer, stating Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified handicapped employees and applicants for employment and the rights and remedies available.
10. Contractor will notify each labor union or representative of workers with which he/she has a collective bargaining agreement or other contract understanding, that he/she is bound by the terms of Section 503 of the Rehabilitation Act, and is committed to take affirmative action to employ and advance in employment, physically and mentally handicapped individuals.
In the event this contract exceeds \$100,000 and provides for performance in 90 days or more, Contractor further agrees as follows:
 11. Contractor agrees to submit a copy of his/her affirmative action program to the State Equal Opportunity Office within 30 days after the award of a contract or sub-contract.
 12. Contractor agrees to submit a summary report to the State of Rhode Island and Providence Plantations Equal Opportunity Office by March 31 of each year during performance of the contract and by March 31 of the year following completion of the contract, in the form prescribed by State Equal Opportunity Office covering employment and complaint experience accommodations made and all steps taken to effectuate and carry out the commitments set forth in the affirmative action program.

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XXIV. CERTIFICATE OF NON-SEGREGATED FACILITIES

Contractor certifies that he/she does not maintain or provide for his/her Employees any segregated facilities at any of his/her establishments, and that he/she does not permit his/her employees to perform their services at any such location, under his/her control, where segregated facilities are maintained. He/she certifies further that he/she will not permit his/her employees to perform their services at any location, under his/her control, where segregated facilities are maintained. Contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this contract. As used in this certification, the term "Segregated Facilities" means any waiting room, work areas, rest rooms, and wash rooms, restaurants and other eating areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are, in fact, segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. He/she further agrees that (except where he/she has obtained identical certifications from proposed subcontractors for specific time periods), he/she will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000, which are not exempt from the provisions of the Equal Opportunity Clause; that he/she will forward the following notice to proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods).

XXV. NOTICE OF PROSPECTIVE SUBCONTRACTORS
OF REQUIREMENT FOR CERTIFICATION OF NONSEGREGATED
FACILITIES

A Certificate of Non-segregated Facilities must be submitted prior to the award of a sub-contract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each sub-contract or for all subcontracts during a period (i.e. quarterly, semi-annually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 USA 1001.

A. Affirmative Action Compliance Program

Contractor agrees to develop a written Affirmative Action Compliance Program for each of its establishments as required by Section 60-1.40 of Title 41 of the Code of Federal Regulations.

B. Employer's Information Report (EE)-1 Form 100

Contractor agrees to file in duplicate, Standard Form 100, entitled, "Equal Employment Opportunity Employer Information Report EEO-1" as required by Section 60-1.7 of Title 41 of the Code of Federal Regulations.

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Send original copy to Federal authorities, duplicate copy to the State Equal Opportunity Office, 1 Capitol Hill, Providence, Rhode Island 02908-5865.

C. **Notice to All Vendors**

If it should be determined by the State Equal Opportunity Office that any company doing business with the State is guilty of non-compliance with the provisions of this document, said company will be given two (2) written warnings. If the said company does not comply immediately after the second written notice, then the State Equal Opportunity Office will notify the Rhode Island Public Transit Authority, who shall have the authority to have the contract **revoked** and all contractual obligations of the State dealing with the contract in question will be **null** and **void**.

D. **Post Award Conference**

Post Award Conference for the Implementation of Affirmative Action prior to Signing of Contract.

E. **Signature Required**

Failure to provide a signature prior to Award to successful Bidder shall be cause for Rejection of Bid.

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**XXVI. GENERAL CONTRACT COMPLIANCE CERTIFICATE
& AGREEMENT FORM**

(Equal Employment Opportunity)

Authorized Signature: _____

Print Name: _____

Title: _____

Company Name: _____

Date: _____

Indicate Job Location Address: _____

BID NO. 20-05

XXVII. DAVIS BACON ACT COMPLIANCE

I certify that I will comply with the Provisions of the Davis-Bacon Act for this project. I certify that I will pay the applicable Prevailing Wages as listed at the following web address:

<http://www.access.gpo.gov/davisbacon/ri.html>

Authorized Signature: _____

Print Name: _____

Title: _____

Company Name: _____

Date: _____

Indicate Job Location Address: _____

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XXVIII. CERTIFICATION OF PRIMARY PARTICIPANT FORM

Invitation for Bids Number: 20-05
Project Chaffee Building Rehabilitation

The primary participant _____, certifies to the best of its knowledge and belief, that it and its principals:

- 1) Are not presently debarred, suspended, proposed for debarment, declared eligible, or voluntarily excluded from covered transactions by any Federal Department or Agency;
- 2) Have not within a three-year period preceding this Bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- 3) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph (2) of this certification; and
- 4) Have not within a three-year period preceding this application/Bid had one or more public transactions (Federal, State, or Local) terminated for cause or default.
- 5) The Primary Participant also certifies that, if it later becomes aware of any information contradicting the statements of Paragraphs 1-4 above, it will promptly notify RIPTA.

The primary participant _____, certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of 31 U.S.C Sections 3801 **ET SEQ.** are applicable thereto.

Signature/Title of Authorized Official

Date

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XXIX. DEBARMENT CERTIFICATION

**CERTIFICATION REQUIREMENTS FOR RECIPIENTS OF GRANTS
AND
COOPERATIVE AGREEMENTS
REGARDING DEBARMENT AND SUSPENSIONS**

The purpose of the attached certifications is to exclude entities and individuals that the Federal Government has either debarred or suspended from obtaining Federal assistance funds through grants, cooperative agreements or third party contracts.

To assure that such entities and individuals are not involved in projects financed with Federal Transit Administration (FTA) assistance, FTA requires its applicants to complete the certificates.

The primary participant must sign the "**Certification of Primary Participant**" and, if there is a subcontractor, they must sign the "**Certification of a Subcontractor**" (If there is more than one subcontractor, they must all sign one of these forms.).

XXX. CERTIFICATION OF A SUBCONTRACTOR FORM

Invitation for Bids Number: 20-05

Project **Chaffee Building Rehabilitation**

The potential Subcontractor, _____
Certifies, by submission of this certification, that neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from participation in this transaction by any Federal Department or agency.

The Subcontractor, _____ certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of 31 U.S.C. Sections 3801 **ET SEQ.** are applicable thereto.

Signature/Title of Authorized Official

Print Signature

Date

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XXXI. NON-RESIDENT CONTRACTOR INFORMATION

From: Department of Administration
Division of Taxation
289 Promenade Street
Providence, RI 02908

Notice: "To All Persons Engaging Non-Resident Contractors"
Regulation Re: Contractors and Subcontractors - "Regulation C"
Article III, Non-Resident Contractors

Any individual, partnership, joint venture, corporation, state, municipal government or exempt organization awarding a construction contract in Rhode Island to a non-resident contractor (as hereinafter defined) is required, pursuant to Section 44-1-6 of the General Laws, as last amended, to withhold 3% of the contract price to secure payment of any sales and use tax or income tax withheld, or both, that may be due to the State of Rhode Island in carrying out the contract.

Upon completion of the contract, the non-resident contractor is required to notify the Tax Administration shall, within 30 days after receipt of the request, audit the records and provide by certified mail to the person holding the funds and to the non-resident contractor, either a certificate of no tax due or a notice of taxes due.

The person holding the funds is required to pay to the Tax Administrator the amount set forth in the notice of taxed due, including interest and penalties, but not in excess of 3% of the contract price. Monies withheld in excess of taxes due the Tax Administrator may be paid to the non-resident contractor.

If the Tax Administrator does not furnish a certificate of no tax due or a notice of taxes due within 30 days after receipt of the request for the making of the audit, the person holding the funds may remit the full amount due to the non-resident contractor. The Tax Administrator shall not have any claim against such funds in the hand of the person holding the funds.

DEFINITION OF NON-RESIDENT CONTRACTOR

"A non-resident contractor is one who does not maintain a regular place of business in this state. A regular place of business shall be deemed to mean and include any bona fide office (other than a statutory office), factory, warehouse or other space in this state at which the taxpayer is doing business in its own name in a regular and systematic manner and which is continuously maintained, occupied and used by the taxpayer in carrying on its business through its regular employees regularly in attendance. A temporary office at the site of construction shall not constitute a regular place of business".

In order to effectively implement this legislative change, which became effective on passage, non-resident contractors shall forward such notice of completion by certified or registered mail (in duplicate) to the Division of Taxation.

R. Gary Clark
Tax Administrator

RHODE ISLAND PUBLIC TRANSIT AUTHORITY

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XXXII. DRUG & ALCOHOL TESTING PROGRAM

In accordance with the Federal Transit Administration Rules 49 CFR 40, 653, and 654, pertaining to prohibited drug use and Contract Service Providers who perform safety-sensitive functions as follows:

- Operation of Revenue Service Vehicles In and Out of Service.
- Dispatch or Control Movement of Revenue Service Vehicles.
- Maintain, Repair and Inspect Revenue Service Vehicle.

The standards they must meet are:

1. Provide each employee performing a RIPTA safety-sensitive function a copy of RIPTA's Prohibited Drug Use and Alcohol Misuse Policy and Procedures. Each Employee must sign and return to RIPTA "Confirmation of Receipt" form.
2. Provide RIPTA with documentation that all employees, both full and part-time, participate in a prohibited drug use testing program in compliance with 49 CFR 653 and an alcohol misuse testing program in compliance with 49 CFR 654. Documentation must be provided which insures that all testing is performed in compliance with 49 CFR 40.
3. Provide to RIPTA's, by February 1st, following each calendar year, annual Management Information Systems (MIS) reports for submission to the FTA. The MIS form used must be that which is contained in 49 CFR 653 and 654.
4. Identify a contact person responsible for handling all 49 CFR 40, 653 and 654 regulation compliance.

XXXIII. DRUG AND ALCOHOL POLICY ACKNOWLEDGEMENT **CONTRACT SERVICE PROVIDER** **ACKNOWLEDGEMENT AND CONFIRMATION OF RECEIPT**

Employee Name: _____

Company Name: _____

I have received a copy of Rhode Island Public Transit Authority's Prohibited Drug Use and Alcohol Misuse Policy and Procedures.

Employee
Signature: _____

Date: _____

Return To: Drug and Alcohol Test Coordinator
Department of Human Resources
Rhode Island Public Transit Authority
Room 217
705 Elmwood Avenue
Providence, Rhode Island 02907

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State of Rhode Island, Department of Labor and Training, Division of
Workers' Compensation

P.O. Box 20190, Cranston, RI 02920-0942

Phone (401) 462-8100 TDD (401) 462-8084 www.dlt.ri.gov

XXXIV. NOTICE OF DESIGNATION AS INDEPENDENT CONTRACTOR

PURSUANT TO RIGL §28-29-17.1

Please read the second page

No one can force you to sign this form. When you sign this form, you are stating that you are an independent contractor and in the event of injury, are not entitled to workers' compensation benefits.

(Name) _____ Soc. Sec. No. _____

Business Name _____ FEIN: _____

Business License No. _____

Address _____ Date of Birth _____

I declare that I am an independent contractor pursuant to RIGL §28-29-17.1 and, therefore, I am not eligible for nor entitled to Workers' Compensation benefits pursuant to Title 28, Chapters 29-38, of the Workers' Compensation Act of the State of Rhode Island for injuries sustained while working as an independent contractor for the hiring entity named below. This designation will remain in effect while performing services for the named hiring entity or until a withdrawal of designation as independent contractor form is filed with the Department of Labor and Training.

Hiring Entity Name _____ Soc. Sec. No. _____

Address _____ Business License No. _____

Warning! This form is for purposes of Workers' Compensation only and completion of this form does not mean that you are an Independent Contractor under the rules, regulations or statutes of the Internal Revenue Service or the RI Division of Taxation. Information on this form will be shared within the Dept. of Labor and Training, the RI Division of Taxation and the Internal Revenue Service.

Independent Contractor:

Signature

Date

A hiring entity that knowingly assists, aids and abets, solicits, conspires with or coerces an employee to misrepresent the employee's status as an independent contractor may be subject to criminal prosecution under RIGL §28-33-17.3.

*** This information is available to the public including the Hiring Entity's Workers' Compensation Insurance Carrier.**

The Department will mail a confirmation of this filing to the independent contractor within five business days. If you have any questions, call 462-8100, option 5.

DWC-11-IC (3/2006)

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DWC-11-IC Reverse Side

This is a form DWC11-IC, Designation of Independent Contractor. This means that you have stated that you are an independent contractor NOT an employee and are NOT eligible for Workers' Compensation benefits.

Many factors are considered when determining whether someone is an employee or an independent contractor. Some of those factors are: independent contractors set their own work hours, have their own tools and work when and for whom they choose.

An employer generally does not have to withhold or pay any taxes on payment to independent contractors, such as social security, Medicare, unemployment and Temporary Disability Insurance (TDI).

This form is for purposes of Workers' Compensation, and completion of this form does not mean that you are considered an Independent Contractor under the rules, regulations or statutes of the Internal Revenue Service or the R.I. Division of Taxation.

SHOULD YOU HAVE ANY QUESTIONS ABOUT WHETHER YOU ARE AN INDEPENDENT CONTRACTOR OR AN EMPLOYEE, PLEASE CONTACT THE RI DIVISION OF TAXATION AT (401) 222-3682, OR THE US GOVERNMENT INTERNAL REVENUE SERVICE AT 800-829-1040.

IF YOU FEEL YOU HAVE BEEN COERCED OR FORCED TO SIGN THE INDEPENDENT CONTRACTOR FORM, REPORT THIS TO THE WORKERS' COMPENSATION FRAUD AND COMPLIANCE UNIT AT (401) 462-8100, option 7.

When your work as an independent contractor ends with this employer, complete and return the form titled Notice of Withdrawal of Designation as Independent Contractor, DWC-11-ICR, to the Dept. of Labor and Training, Division of Workers' Compensation.

If you have a question, contact the Division of Workers' Compensation at (401) 462-8100, option 5. For further information, contact the Workers' Compensation Information Line at (401) 462-8100, option 1.

DWC-11-IC (3/2006) Side 2

Request for Taxpayer
Identification Number and Certification

Give Form to the
requester. Do not
send to the IRS.

Print or type See Specific Instructions on page 2.	Name (as shown on your income tax return)	
	Business name/disregarded entity name, if different from above	
	Check appropriate box for federal tax classification: <input type="checkbox"/> Individual/sole proprietor <input type="checkbox"/> C Corporation <input type="checkbox"/> S Corporation <input type="checkbox"/> Partnership <input type="checkbox"/> Trust/estate <input type="checkbox"/> Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=partnership) ▶ _____ <input type="checkbox"/> Other (see instructions) ▶ _____	Exemptions (see instructions): Exempt payee code (if any) _____ Exemption from FATCA reporting code (if any) _____
	Address (number, street, and apt. or suite no.)	Requester's name and address (optional)
	City, state, and ZIP code	Rhode Island Public Transit Authority 705 Elmwood Avenue Providence, RI 02907
List account number(s) here (optional)		

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on the "Name" line to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Social security number								

Note. If the account is in more than one name, see the chart on page 4 for guidelines on whose number to enter.

Employer identification number								

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and
3. I am a U.S. citizen or other U.S. person (defined below), and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions on page 3.

Sign Here	Signature of U.S. person ▶	Date ▶

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. The IRS has created a page on www.irs.gov/w9 for information about Form W-9, at www.irs.gov/w9. Information about any future developments affecting Form W-9 (such as legislation enacted after we release it) will be posted on that page.

Purpose of Form

A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, payments made to you in settlement of payment card and third party network transactions, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the

withholding tax on foreign partners' share of effectively connected income, and

4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct.

Note. If you are a U.S. person and a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

- An individual who is a U.S. citizen or U.S. resident alien,
- A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States,
- An estate (other than a foreign estate), or
- A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax under section 1446 on any foreign partners' share of effectively connected taxable income from such business. Further, in certain cases where a Form W-9 has not been received, the rules under section 1446 require a partnership to presume that a partner is a foreign person, and pay the section 1446 withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid section 1446 withholding on your share of partnership income.

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XXXV. GENERAL DESCRIPTION OF PROJECT SCOPE

(Please refer to attached drawings and related information for detailed information)

A. Mechanical:

1. Replacement of (5) gas fired make-up air units serving the RIPTA Bus Maintenance Area.
2. Replacement of exterior ductwork and insulation from each of the (5) make-up air units.
3. Replacement of (2) roof mounted utility set exhaust fans and exterior ductwork.
4. Replacement of (1) 4 ton packaged rooftop gas fired/electric cooling rooftop unit.
5. New CO/NO₂/CH₄ gas monitoring system for the bus maintenance area.
6. New building management controls for the existing HVAC equipment serving the bus maintenance area.
7. New duct & equipment supports for all new HVAC roof mounted equipment.
8. New supply grilles serving the bus maintenance area.
9. New gas connections to each new gas fired rooftop unit.
10. Cleaning of existing supply ductwork serving the bus maintenance area.

B. Electrical:

1. Disconnecting and removing power and control wiring to (5) gas fired make-up air units.
2. Disconnecting and removing power wiring to (2) roof exhaust fans.
3. Disconnecting and removing power wiring to (1) gas fired/electric cooling unit.
4. Disconnecting and removing make-up air unit smoke detectors.
5. Disconnecting and removing power panel associated with the mechanical equipment.
6. Providing new panel for new mechanical equipment with new feeder and new wiring to all new equipment.
7. Providing new duct smoke detectors and wiring for new make-up air units.
8. Power to new CO/NO₂/CH₄ gas monitoring system control panel.
9. Disconnection and removing power wiring from lift console to lift motor. Power wiring to lift console shall remain.
10. Removal of lift control panel and installation of junction box for extension of existing power supply to new lift console.
11. Providing lift power and control wiring and raceways.

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C. **Plumbing:**

1. Remove existing compressed air to existing bus lifts.
2. Remove existing bus lift drain connection to existing oil water separator.
3. Extend existing drains per drawings to new bus lift floor elevation prior to pouring concrete fill.
4. Install new compressed air lines, air valves, and regulator filter lubricators to new bus lifts.
5. Install new floor drain grate and trap seal.

D. **Structural:**

1. Fill in existing pit areas where openings are not needed for new pits.
2. Modify existing slab-on-grade to accommodate new lifts and install new foundations as indicated on the plans.
3. Trench and patch existing concrete slab-on-grade to accommodate new plumbing work as required.
4. Install new roof dunnage to support new RTU's and ductwork as indicated on the plans.
5. Replace existing roof membrane in area of RTU replacement.

XXXVI. **TIME FOR PROJECT COMPLETION**

The Project must be completed within 180 calendar days after receipt of a Purchase Order from the Authority.

XXXVII. **LIQUIDATED DAMAGES**

Liquidated Damages will be assessed at the rate of \$500.00per calendar day after the Project Completion Date listed above

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XXXVIII. **PROJECT MANUAL**

XXXIX. **PROJECT DRAWINGS**

Project Manual 750 Elmwood Avenue Bus Lift Replacement

RIPTA
Providence, Rhode Island

February 2020



Fuss & O'Neill, Inc.
317 Iron Horse Way, Suite 204
Providence, RI 02908



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END OF SECTION

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 Related Documents

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.

1.3 Definitions

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 Materials Ownership

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 Preinstallation Meetings

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 Informational Submittals

- A. Qualification Data: For refrigerant recovery technician.

- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 Closeout Submittals

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 Quality Assurance

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 Field Conditions

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.

- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 Warranty

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 Performance Requirements

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 Examination

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 Utility Services And Mechanical/Electrical Systems

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 Preparation

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building. Construct temporary barriers as required to control dust during saw-cutting operations.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 Selective Demolition, General

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 Selective Demolition Procedures For Specific Materials

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- C. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.6 Disposal Of Demolished Materials

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 Cleaning

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**PART 1 - GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Slabs-on-grade.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.3 Definitions

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 Action Submittals

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.

1.5 Informational Submittals

- A. Qualification Data: For Installer, manufacturer, testing agency
- B. Welding certificates.

- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.

- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

- F. Field quality-control reports.

- G. Minutes of preinstallation conference.

1.6 Quality Assurance

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

- C. Testing Agency Qualifications: An independent testing agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 Delivery, Storage, And Handling

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 Form-Facing Materials

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.2 Steel Reinforcement

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 Reinforcement Accessories

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 Concrete Materials

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.5 Admixtures

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 Waterstops

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Greenstreak.
 - b. Williams Products, Inc.
 - 2. Profile: Flat, dumbbell with center bulb
 - 3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

2.7 Vapor Retarders

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra 10 .
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Insulation Solutions, Inc.; Viper VaporCheck 10.
 - e. Meadows, W. R., Inc.; Perminator 10 mil.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.8 Curing Materials

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 200.
 - b. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - c. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - d. Meadows, W. R., Inc.; 1100-CLEAR.

2.9 Related Materials

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
- E. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 Repair Materials

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 Concrete Mixtures, General

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Combined Fly Ash and Pozzolan: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.12 Concrete Mixtures For Building Elements

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery 3/4-inch nominal maximum aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.13 Fabricating Reinforcement

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 Concrete Mixing

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 Formwork

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 Embedded Items

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 Removing And Reusing Forms

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 Shores And Reshores

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 Vapor Retarders

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturers recommended tape.

- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
 - 1. Place and compact a 1/2-inch-thick layer of fine-graded granular material over granular fill.

3.6 Steel Reinforcement

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- D. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 Joints

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will

not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 Waterstops

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.9 Concrete Placement

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 Finishing Formed Surfaces

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 Finishing Floors And Slabs

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel

marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

3.12 Miscellaneous Concrete Items

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.13 Concrete Protecting And Curing

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 Joint Filling

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 Concrete Surface Repairs

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square

cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.16 Field Quality Control

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

3.17 Protection Of Liquid Floor Treatments

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING**PART 1 - GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

- A. Section Includes:
 - 1. Structural steel.

1.3 Definitions

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 Coordination

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 Preinstallation Meetings

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 Action Submittals

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.
- D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 Informational Submittals

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.8 Quality Assurance

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P2 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 Delivery, Storage, And Handling

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 Performance Requirements

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type PR, partially restrained.
- C. Construction: Braced frame.

2.2 Structural-Steel Materials

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992.
- C. Channels, Angles, Shapes: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.
- F. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 Bolts, Connectors, And Anchors

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 Primer

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.
- C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- D. Galvanizing Repair Paint: SSPC-Paint 20.

2.5 Fabrication

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.

2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 Shop Connections

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 Shop Priming

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
 6. Surfaces enclosed in interior construction.
- B. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- C. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 Galvanizing

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize all exterior structural steel.

2.9 Source Quality Control

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 2. Ultrasonic Inspection: ASTM E 164.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 Examination

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 Erection

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in

permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 Field Connections

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 Field Quality Control

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.

- E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 Repairs And Protection

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

SECTION 14 45 00 – VEHICLE LIFTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scissors style in-ground lifts – Steril Koni ECO 60 *ebright*.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Concrete: Footings and foundations.
- B. Section 26 05 00 - Common Work Results for Electrical.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Submit drawings showing full layout of all lifts with dimensions and details shown for services and conduits between lifts and the control consoles.
- D. Operation and Maintenance Manual: Submit Owner's manual to include system operation, maintenance and troubleshooting, spare part numbers, drawings and schematics.

1.4 QUALITY ASSURANCE

- A. Manufacturer qualifications: The lift company selling the product shall possess ISO-9001 certification.
- B. Installer qualifications: For warranty validation, installation shall be performed by qualified factory authorized and trained personnel.
- C. Product requirements / design standards and certification: The lift shall be certified by a Nationally Recognized Testing Laboratory (NRTL) to the ANSI/ALI ALCTV (current edition) “Standard for Automotive Lifts: Safety Requirements for Construction, Testing, and Validation”.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

- A. Manufacturer's Warranty: Lift system shall be warranted for a minimum period of 2 years for parts and 1 year for labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturer: Stertil-Koni USA, Inc., which is located at: 200 Log Canoe Circle; Stevensville, MD 21666; Toll Free Tel: 800-336-6637; Tel: 410-643-9001; Email: lifts@stertil-koni.com; Web: www.stertil-koni.com
- B. Substitutions: Not permitted.

2.2 SCISSOR STYLE IN-GROUND LIFTS

- A. Scissor style in-ground Lift Model ECO60 as manufactured by Stertil-Koni USA, Inc.
 - 1. General Description:
 - a. The lift shall consist of two lifting units in line with the longitudinal axis of the vehicle, each lifting unit so equipped as to engage the axle, suspension, and/or frame as specified herein. One of the two lifting units shall be movable fore and aft to affect variable spacing between lifting mechanisms. The other lifting unit shall be fixed.
 - 2. Lifting Capacity:
 - a. Lift shall be capable of raising 60,000 lbs. (27,216 kg), 30,000 lbs. (13,608 kg) each fixed/ 30,000 lbs. (13,608 kg) each movable lifting unit.
 - b. Unbalanced Loads, Movable to Fixed: Lift shall be capable of raising 30,000 lbs (13,608 kg) on one unit and 0 lbs (0 kg) on the other unit.
 - 3. Dimensions:
 - a. The lifting height shall be no less than 70 inches (1,780 mm) as measured from the point of adapter contact at full rise to the finished floor.
 - b. Lifting Rate: 90 seconds; 45 inches (1,140 mm) per minute, minimum.
 - c. Maximum depth below finished floor for any structural component or member: 34 inches (864 mm) maximum.
 - d. Movable and fixed lifting unit synchronization: 2 inches (51 mm).
 - e. Travel range for the movable lifting unit shall be as follows, depending on selected model:
 - 1) ECO 60-3.25: 39 inches (991 mm)
 - 2) ECO 60-10: 120 inches (3,048 mm)
 - 3) ECO 60-13: 156 inches (3,962 mm)
 - 4) ECO 60-17: 204 inches (5,182 mm)
 - 4. Lifting Units:
 - a. Lifting units and continuous recess insert shall be completely removable with no lift components or structural framing permanently embedded in the concrete.

- b. Lifting units shall be hydraulically powered, mechanically articulating scissors, complete with a mechanical locking system.
 - c. All steel surfaces shall be powder coated.
 - d. By means of a centering link, the lifting unit structure shall articulate symmetrically about the center axis of the lift unit as it raises and lowers.
5. Movable Lifting Unit:
- a. The movable lifting unit shall relocate horizontally fore and aft while in the fully retracted position.
 - b. When the entire continuous recess insert has the covers in place and the lift is operational, it shall form a continuous recess that shall meet the following design and performance criteria:
 - 1) The movable lifting unit shall not be required to recess, or park, in only one "pocketed" location, providing increased productivity in servicing fleet vehicles of varying wheelbases.
 - 2) The movable lifting unit may be recessed below finished floor at any position between the minimum and maximum dimensions of the travel range.
 - 3) The movable lifting unit shall be capable of fore and aft travel while recessed below floor.
 - c. Maximum depth below finished floor for the continuous recess insert, rear lifting unit or any fixed or movable component shall be 34 inches (864 mm).
 - d. The movable steel box insert shall have an open floor design, mounted off the concrete floor of the trench to allow for the collection, cleaning and drainage of all liquids and solids that accumulate in the trench.
 - e. The aluminum covers for the movable mechanism shall be anodized structural 6061 aluminum extrusions engineered to accept a 7,500 lb. (3,402 kg) point load on a contact area of 2 x 2 inches (50 x 50 mm) and shall be shaped to include a full-length interlocking hinge. Covers shall fit together tightly and uniformly to promote smooth travel so as to prevent jamming and twisting. The covers shall be able to accept a 13,500 lb. (6,123 kg.) drive over load on a 6 x 9 inch (152 x 228 mm) contact area.
 - f. The aluminum covers for the movable mechanism shall be attached to UHMW slider blocks for reduced friction and increased longevity. These slider blocks shall keep the covers properly centered at all times. Horizontal grooves in the UHMW sliders shall, together with half-moon shaped guide rails in the end section of the lift's steel box insert, securely guide the covers as they travel in and out of the recess.
 - g. Transition plates shall be bolted to the continuous recess insert to provide for a flush and smooth transition from the shop floor to the aluminum covers. The transition plates also shall assist the cover travel by holding the covers down so they can't buckle during horizontal travel.
 - h. The aluminum covers for the movable mechanism shall be flush with the finished floor within a tolerance of less than 1/8 inch. Covers that are lower than the finished floor shall not be acceptable.
 - i. The movable lifting unit and the covers shall bear on and slide over UHMW surfaces for low friction and minimal maintenance.
 - j. The hydraulically powered carriage drive shall utilize a rack and gear arrangement on both the left and right sides for smooth and even fore-aft travel without binding.

- k. The rack shall be inverted and positioned under the load channel of the movable lifting unit insert where it is protected so as not to collect dirt, grease etc.
 - l. All hydraulic and compressed air service lines shall be fed from the control console to the movable lifting unit insert through one PVC chase way per lifting unit.
 - m. All low voltage, intrinsically safe electric service lines shall be fed from the control console to the movable lifting unit insert through one $\frac{3}{4}$ inch rigid conduit per lifting unit, installed to meet local requirements.
6. Fixed Lifting Unit:
- a. The fixed lifting unit shall be bolted in place with eight each $\frac{7}{8}$ inch (22 mm) stainless steel anchors.
7. Hydraulic System:
- a. System shall be comprised of two high pressure, low volume, single acting, 7 inch (178 mm) diameter cylinders, one in each lifting unit.
 - b. The hydraulic system shall be a power up / gravity down design. Lifts that rely on the power units to run during the lowering cycle shall not be acceptable due to increased power consumption and wear.
 - c. High pressure seals shall be internal to the cylinder, where they are protected from salt, dirt, etc.
 - d. Each cylinder shall require no more than 3.5 gallons (13.25 liters) of hydraulic fluid for lifting to full height.
 - e. Combined, the two cylinders shall only require 7 gallons (26.5 l) of AW 15 hydraulic fluid for lifting to full height.
 - f. Each cylinder shall have a hose break velocity fuse (safety check valve) integrally mounted to prevent excessive loss of fluid from the cylinder.
 - g. The hoses shall be of reinforced construction and utilize JIC fittings throughout.
 - h. The hoses feeding the movable lift carriage shall be supported and contained by a cable carrier to prevent the hoses from dragging or tangling.
 - i. The lift shall be driven by two individual power units, readily available as an off-the-shelf component.
8. Adapters:
- a. The lift system shall include a variety of axle engaging accessory adapters designed to raise heavy vehicles by the axles or frame. Adapters shall be either axle or frame oriented. Spinning adapters shall not be acceptable due to risk of accidental rotation during vehicle spotting and setup.
 - b. The base adapter shall have at least a five hole pattern that will allow every accessory adapter to be used in the reverse direction, allowing up to eight positions of the accessory adapter on the base adapter.
 - c. Sliding base adapters shall be restrained to prevent over extension.
 - d. Bolster and base adapters for all lifting units shall recess below finished floor.
 - e. Adapter Adjustment: Minimum 13.25 inches (337 mm); Maximum 56 inches (1,422 mm).
 - f. Bolster Width: 40 inches (1,016 mm) minimum.
9. Controls:
- a. The control system shall conform to all current NEC, UL 201 and OSHA codes.

- b. The control system shall be PCB operated and continuously monitor all operating functions and safety systems of the lifting units.
- c. The control system shall utilize intrinsically safe inclinometers to constantly monitor the elevation of the lifting units to ensure synchronized operation.
- d. The control system shall allow the user to adjust the sensitivity of the electronic synchronization without the use of special tools, within the absolute limits of ANSI/ALI ALCTV standard.
- e. The control system shall have the ability to receive regular software updates/upgrades as control system advances become available. All updates/upgrades shall be possible through data transfer without the need for component replacement.
- f. On the face of the control console, control elements shall include:
 - 1) "UP" button.
 - 2) "Down" button.
 - 3) "Lock release" button.
 - 4) "Confirm" button
 - 5) A high definition 7 inch (178 mm) LCD screen touch screen. The touch screen shall be specifically designed for a harsh workshop environment. The touch screen shall provide systems information, but operation of the lift shall be initiated by the primary operational buttons. The touch screen shall include a removable micro-SD memory card for storage of user configurable information. The touch screen shall be capable of providing the following functions:
 - a) "Lifting unit selection" indicator: displays to the operator which lifting units in the lift have been selected for operation. The display illustrates the ability to operate the lifting units singularly, or all lifting units as a synchronized set.
 - b) "Lifting unit height" indicator: displays to the operator the height of each individual lifting unit. The height indicator shall also provide, on the touch screen, a clear indicator if the lifting unit has been set to stop at a restricted lifting height.
 - c) "Lifting units fully lowered" indicator: displays to the operator that all lifting units are fully retracted into the ground to inform the operator that the bay is clear to allow entry and exit by the vehicle.
 - d) "Error message" indicator: displays to the operator when a fault code has been registered by the control system, the touch screen shall inform the operator of any fault situations being present in the lift. The control system shall have the ability to display error messages including fault description on the screen.
 - e) One-touch access to the **Guide screen**: This area of the touch screen provides to the operator:
 - i. Owner information
 - f) One-touch access to the **Information screen**: This area of the touch screen provides to the all users:
 - i. Owner information
 - ii. Contact information for service provider
 - iii. Equipment time log including lifting unit run times

- g) One-touch access to the **Settings screen** which displays various options. The settings screen shall allow control of:
 - i. Settings screen option (1): authorized users shall have the ability to change the language (English, Spanish, French) displayed on the screen as well as the units of measure for height and weight (imperial or metric units).
 - ii. Settings screen option (2): authorized users shall have the ability to retract the mechanical locks during raising for reduced noise, as well as to set a restricted maximum lifting height.
 - iii. Access to the Shop and Assistance screens: from the Settings screen, authorized users shall have the ability to control the service settings.
- h) One-touch access to the **Shop configuration screen** options which is PIN protected. The shop configuration screen shall allow adjustment of:
 - i. Edit of owner's details: allows the ability to edit the information displayed on the Owner's field.
- i) One-touch access to the **Assistance configuration screen** which displays various options and is PIN protected. The maintenance configuration screen shall allow adjustment of:

Screen 1

- i. Initiation of crush protection which guards against a crushing hazard during lowering when using the optional remote control. This safety system, when enabled, will interrupt lowering as the lift reaches 18 inches (457 mm) above finished floor. At that time, the operator needs to return to the control console and continue the lowering cycle by utilizing the control buttons located on the face of the control console.
- ii. Ability to disable height difference monitoring to aid in trouble shooting. Once initiated, this control system option allows the maintainer to operate the lifting system outside normal safety limits. This system is only for use by the lift system maintainer during repair procedures. This system option will automatically be disabled and the control system returned to default operating parameters after 10 minutes.

Screen 2

- i. Ability to view lift system run time to properly plan for lift system maintenance.
- ii. Ability to view individual lifting unit motor run time to properly plan for lift system maintenance.

Screen 6

- i. This screen shall allow back up of the operating system

Screen 7

- i. This screen shall display operating system information

- g. The enclosure for electrical control components shall be IP 54 rated.
- h. The control console shall be equipped with a main power disconnect

- switch which interrupts all incoming power. Main power disconnect shall be lock-out capable.
- i. Control console access panels shall have key-hole slots and recessed handles for easy removal and installation.
 - j. The control system shall automatically prohibit horizontal movement of the movable lifting unit when raised above 12 inches (305 mm) above finished floor. This parameter shall be user programmable without the use of special tools.
 - k. The lift, when fitted with the proper electrical motors, shall operate at the following voltages: 208/230V (3 phase), 460V (3 phase), 575V (3 phase)
10. Safety Devices:
- a. Each lifting unit shall be equipped with double lock jaw, gravity engaged, mechanical locks with the first lock position engaging at a minimum height of 18 inches (457 mm).
 - b. Number of Mechanical Lock Stops: 12, minimum.
 - c. Vertical height spacing between each lock stop: 6 inches (152 mm), maximum.
 - d. The mechanical locks shall be made of high strength T-1 steel.
 - e. All push buttons shall be of momentary contact, dead man type.
11. Optional: Automatic Wheel Base Positioning:
- a. The control system shall be equipped with an AWBP (automatic wheel base positioning) system that allows the operator to program an infinite number of wheelbase positions into the control system for reduced set up times. The AWBP system shall be controlled via the 7 inch (178 mm) color touch screen to allow the operator to select and program vehicle wheel bases. The AWBP system shall allow the operator to store wheel base positions by vehicle brand and year or license plate for ease of use and safety to avoid selection of the incorrect vehicle. Once a vehicle has been selected, the movable lifting unit shall travel to the pre-programmed position without interruptions or stops.
12. Optional: Wired Remote Control:
- a. The lift shall be equipped with an ergonomic industrial remote control, rated for use in NEC Class 1, Div. 2, hazardous locations.
 - b. Remote control shall be connected to the control console through a multi-conductor cable with military-style DIN connector. Standard cable length shall be 35 feet. (10.6 m)
 - c. Remote control shall allow full function control of the lift, with the following:
 - 1) Push/Pull E-Stop Button
 - 2) Push buttons for Lift Raise, Lower and Unlock
 - 3) Selector button for synchronized (group) or single operation
 - 4) Push buttons for hydraulic movable carriage drive
 - d. Remote control shall be equipped with an emergency E-Stop button that de-energizes power to all outputs of the PCB. Re-activation of the control system requires resetting the E-Stop and re-energizing the control system.
 - e. The control box shall have a provision to disable operation of the remote control during lowering when the bolster is below 18 inches (457 mm) above finished floor.
13. Optional: HOME Beacon Stack Light:
- a. The lift shall be equipped with an external HOME beacon stack light.

This beacon light shall turn green when all lifting units are fully retraced to inform the operator that the bay is clear to allow entry and exit by the vehicle. When one or more lifting units are not fully lowered the beacon light shall turn red to inform the operator that the bay is not clear and it is not safe to move the vehicle into or out of the bay. The beacon light shall have the option to be mounted in a remote location (e.g. by the bay door) for optimum visibility.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Test for proper operation, and re-test if necessary until satisfactory results are obtained.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**PART 1 - GENERAL****1.1 Section Includes**

- A. Applications.
- B. General requirements.
- C. Ball valves.

1.2 Related Requirements

- A. Section 22 15 00 - General-Service Compressed-Air Systems.

1.3 Reference Standards

- A. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- C. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
- D. ASME B31.9 - Building Services Piping; 2017.
- E. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- F. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.4 Submittals

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS**2.1 Applications**

- A. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball.

- B. Low Pressure, Compressed Air Valves 150 psig (1035 kPa) or Less:
 - 1. 2 NPS (50 DN) and Smaller:
 - a. Bronze: Provide with solder-joint ends.
 - b. Ball: One piece, full port, brass or bronze with brass trim.

2.2 General Requirements

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.
- D. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- E. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 Bronze Ball Valves

- A. Three Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig (1035 kPa).
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body: Bronze.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE
 - 7. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Viega LLC: www.viega.com/#sle.

PART 3 - EXECUTION

3.1 Examination

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.2 Installation

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

END OF SECTION

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**PART 1 - GENERAL****1.1 Section Includes**

- A. Pipe markers.

1.2 Submittals

- A. Product Data: Provide manufacturers catalog literature for each product required.
- B. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 - PRODUCTS**2.1 Pipe Markers**

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 3. MIFAB, Inc: www.mifab.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.
- B. 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.
- C. Color code as follows:
 - 1. Compressed Air: Blue with white letters.

PART 3 - EXECUTION**3.1 Preparation**

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

3.2 Installation

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- C. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.

3. Locate identification not to exceed 20 feet (6 m) 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.

END OF SECTION

SECTION 22 10 06 - PLUMBING PIPING SPECIALTIES**PART 1 - GENERAL****1.1 Section Includes**

- A. Drains.

1.2 Reference Standards

- A. ASME A112.6.3 - Floor and Trench Drains; 2016.

1.3 Submittals

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

PART 2 - PRODUCTS**2.1 General Requirements**

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 Drains

- A. Manufacturers:
 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
 2. Josam Company: www.josam.com/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.

PART 3 - PART 3 EXECUTION**3.1 Installation**

- A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 22 15 00 - GENERAL-SERVICE COMPRESSED-AIR SYSTEMS**PART 1 - GENERAL****1.1 Section Includes**

- A. Pipe and pipe fittings.
- B. Filter/Regulator/Lubricator.

1.2 Related Requirements

- A. Section 22 05 23 - General-Duty Valves for Plumbing Piping.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Identification of piping system.

1.3 Reference Standards

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- E. ASME B31.1 - Power Piping; 2018.
- F. ASME B31.9 - Building Services Piping; 2017.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2018a.
- I. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.
- K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2018.
- L. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- M. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.4 Submittals

- A. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- B. Manufacturer's Instructions: Indicate manufacturer's installation instructions, hoisting and setting requirements, starting procedures.
- C. Operation Data: Submit for pressure reducing station.
- D. Maintenance Data: Submit for pressure reducing station.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

PART 2 - PRODUCTS

2.1 Pipe And Pipe Fittings

- 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: Threaded or welded to ASME B31.1.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, solder, Grade Sn95.

2.2 Unions And Couplings

- A. Unions:
 - 1. Ferrous Pipe: 150 psi (1034 kPa) malleable iron threaded unions.
 - 2. Copper Tube and Pipe: 150 psi (1034 kPa) bronze unions with soldered joints.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- C. Flexible Connector: Neoprene with brass threaded connectors.

2.3 Filter/Regulator/Lubricator (Frl)

- A. Manufacturers:
 - 1. Speedaire
 - 2. Parker
 - 3. Ingersol Rand
- B. Provide FRL per Contract Drawings.

PART 3 - EXECUTION**3.1 Installation**

- A. Install equipment in accordance with manufacturer's instructions.
- B. Install valved drip connections at low points of piping system. Refer to Section 22 05 23.
- C. Install takeoffs to outlets from top of main, with shut off valve after take off. Slope take off piping to outlets.
- D. Identify piping system and components. Refer to Section 22 05 53.

END OF SECTION

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1.0 GENERAL

1.1 GENERAL CONDITIONS

- A. Section includes general mechanical requirements for work specified in all other sections of Division 23, the drawings and schedules.
- B. Subcontractor, unless otherwise qualified, shall mean the installer of the heating, ventilating and air conditioning work.
- C. The work covered by this specification consists of furnishing all materials, labor, equipment and appurtenances to perform, and leave in satisfactory operating condition, all heating, ventilating, air conditioning work, complete, including all tests and adjustments, in strict accordance with the Specifications and the applicable drawings. Completely coordinate work of this section with work of other trades and provide a complete and fully functional installation.
- D. Give notices, file plans, obtain permits and licenses, pay fees and charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements of the contract documents.
- E. Examine the site and all drawings before proceeding with the layout and installation of this work. Arrange the work essentially as shown, exact layout to be made on the job to suit actual conditions. Confer and cooperate with other trades on the job so all work will be installed in proper relationship. Precise location of parts to coordinate with other work is the responsibility of this subcontractor.
- F. As used in these Sections, "provide" means "furnish and install." "Furnish" means to purchase and deliver to the project site complete with every necessary appurtenance and support," and "install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

1.2 SCOPE OF WORK

- A. HVAC work, including but not limited to:
 - 1. Hoisting, rigging, and crane rental as required to complete the HVAC work.
 - 2. Sleeves, inserts, supports, hangers and vibration isolation equipment. This includes all structural steel hangers, pipe racks and accessories to fully carry all piping, ductwork and equipment.
 - 3. Demolition of HVAC related equipment, piping, ductwork, etc. as described in the contract drawings and specifications.
 - 4. Provision and installation of all new HVAC related equipment as described in the contract drawings and specifications.

5. Provision and installation of all new piping, valves, hangers, supports, insulation, and appurtenances as indicated on the contract documents and specified in "HVAC Piping."
6. The Mechanical Contractor shall provide the labor to install wells, threadlets, valves, instrumentation, etc. required for the installation of the ATC control devices. The Mechanical Contractor shall closely coordinate his work with the ATC Subcontractor hired by this Contractor.
7. Provisions for the cleaning, start-up and testing of all HVAC systems.
8. Provisions of shop drawings, equipment submittals and as-built drawings.
9. Provision of installation, operation, and maintenance manuals, and startup instructions.
10. All aerial lifts and scaffolding as required for the new work.
11. Provisions for tags and identification of HVAC systems.
12. The mechanical contractor shall be responsible for all concrete core drilling and saw cutting required to install the piping, equipment, etc. as indicated in the contract drawings and specifications.
13. This contractor shall carry time for field support, start-up and testing personnel and provisions of paperwork as needed to satisfy the commissioning agent requirements.
14. TAB – Air Balancing. Refer to “HVAC Testing, Adjusting and Balancing.”

1.3 CONTRACT DOCUMENTS

- A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and Sections that indicate types of construction in which work shall be installed and work of other trades with which work of this Section must be coordinated.
- B. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational without extra charge to the Owner.
- C. Where drawings and specifications conflict or are unclear, advise Engineer in writing before proceeding with work.

- D. Where drawings and specifications do not coincide with manufacturer's recommendations or with applicable codes and standards, alert Engineer in writing before installation.
- E. Certain details indicated on the Drawings are general in nature and specific labeled detail references to each and every occurrence of use are not indicated; however, such details by their titles shall be applicable to every occurrence on the Drawings.
- F. The Engineer reserves the right to make reasonable modifications to the arrangement of outlets, apparatus and equipment up to the time of roughing piping and ducts without incurring extra cost to the Owner.
- G. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure, and complete installation.
- H. Work shall be performed as described in the Specifications except where specific deviations are indicated and/or noted on the Drawings.
- I. Where specific conflicts occur between the Specifications and the Drawings, the Specifications shall take precedence.
- J. All measurements and dimensions indicated on the contract documents shall be field verified before installation. Notify Engineer of any discrepancies that affect the installation before proceeding.

1.4 CODES AND STANDARDS

- A. The latest published issue of Standards or Recommendations of the following listed Societies, Associations or Institutes in effect three months prior to the date of this contract are part of this Specification. These shall be considered as minimum requirements. Specific requirements of this Specification and/or Drawings shall have precedence. In case of conflict between published requirements, the Owner's Representative or Engineer shall determine which is to be followed.
- B. Where standards or codes are mentioned in these specifications, the latest edition of the revision shall be followed. Where provisions of the contract documents conflict with any standards, codes, laws, rules or regulations, the latter shall govern. Where the contract requirements are in excess of applicable standards, codes, law, rules or regulations the former shall govern, unless otherwise directed. Extra payment will not be allowed for work or changes required by local code or enforcement authorities.
- C. Prior to commencement of work, notify applicable authorities as required and submit all of the required notifications for construction, operation and/or demolition.
- D. Abbreviation and the title of national, state and industry standards, technical societies, associations and institutes and other organizations used throughout this division lists as follows:

(Abbreviation - Title of Organization)

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Air Diffusion Council
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ASME	American Society for Mechanical Engineers
ASTM	American Society for Testing and Materials
FM	Associated Factory Mutual Fire Insurance Companies
IBC	2015 International Building Code with R.I. addendums
IEC	2015 International Energy Code with R.I. addendums
IFC	2015 International Fire Code with R.I. addendums
IMC	2015 International Mechanical Code with R.I. addendums
MCAA	Mechanical Contractors Association of America
MSBC	Massachusetts State Building Code
MSS	Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc.
NAPHCC	National Association of Plumbing, Heating, Cooling Contractors
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code

NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Association
SMACNA	Sheet Metal and Air Conditioning Contractors, National Association, Inc.
TIMA	Thermal Insulation Manufacturers Association
UL	Underwriters' Laboratories, Inc.
UMC	Uniform Mechanical Code

- E. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site.
- F. Equipment and installation must comply with requirements set forth by Owner's Insurance Underwriter.
- G. Equipment shall bear Underwriters' Laboratories labels where applicable.
- H. Installation shall comply with all local and state plumbing regulations.
- I. All materials furnished and all work installed shall comply with the rules and recommendations of the National Fire Protection Association with all requirements of local utility companies, with the recommendations of the Fire Insurance Rating Organization having jurisdiction and with the requirements of the State of Rhode Island and the City/Town for which the project resides.
- J. Any materials or workmanship called for in the above referenced requirements not specified or shown on the drawings shall be furnished and installed by the subcontractors as though the same had been specifically indicated or mentioned. Any work installed in conflict with these requirements shall become the sole responsibility of the subcontractor, who shall assume the expense to rectify the installation to the Engineer's satisfaction.
- K. The subcontractor shall notify the Engineer of any deviations from the above referenced requirements pertaining to work indicated or specified before the installation of this work is affected.

1.5 COORDINATION WITH THE BUILDING TRADES

- A. Structural members and building openings for ducts, piping, etc., for use by the mechanical subcontractor shown on the plans are the coordination responsibility of these subcontractors. Any changes in the above requirements after letting and accepting the respective contract will be paid for by the mechanical subcontractor. Any additional costs incurred due to the information not being provided on time or in error will be paid for by the responsible subcontractor.

1.6 GUARANTEE

- A. Guarantee the Work of this Section in writing for one year following the date of System Acceptance by Owner and Engineer of Record. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Owner's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.
- B. In addition to guarantee requirements of Division 1 and Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.
- C. Submit copies of equipment and material warranties to Owner before final payment.
- D. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to Owner.
- E. This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.
- F. Use of systems provided under this section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.

1.7 SHOP DRAWINGS AND SUBMITTALS

- A. General
 - 1. Shop Drawings are information prepared by the subcontractor to illustrate portions of the work in more detail than shown in the Contract Documents.
 - a. Accompany submittal with transmittal letter containing project name, subcontractor's name, number of samples or drawings, titles, and other pertinent data. Outline deviations, if any, in submittals from requirements of Contract Documents.
 - 2. Each individual submittal item shall be marked to show the specifications section and paragraph number which pertains to the item.
 - 3. Shop drawings shall include printed catalog specifications and printed capacity data to enable confirmation of capacities and specifications which may be shown on certified prints. Where catalogs or data submitted are applicable to several different sizes or types of similar equipment, the vendor shall clearly indicate which piece of equipment or material is to be provided under this contract. If the submittal is not properly marked it will be returned NOT APPROVED.
 - 4. If the subcontractor fails to submit properly marked, complete and prudently timed, shop drawings and thus, causing delays in re-submittal or project schedules, it is the subcontractor's responsibility to do whatever is necessary to meet schedules at no additional cost to the Owner.

5. Shop drawings, catalog specification data and capacity ratings of the following items shall be submitted to the Engineer for approval prior to purchase or installation of any work:
 - a. All equipment scheduled on the drawings. Submittals shall contain, as a minimum, all performance data as listed on schedules so that the Engineer can easily compare manufacturer's data. Submittals not meeting these criteria shall be disapproved.
 - b. As specified in other Division 23 Sections.
6. Engineer's review of shop drawings is for general conformance with the design concept and contract documents. Marking or comments shall not be construed as relieving the subcontractor from compliance with the project plans and specifications, nor departures there from. The subcontractor remains responsible for details and accuracy.
7. This subcontractor is responsible for the dimensions and arrangement of equipment as it is applied to this project. Any adaptation, modification or addition is the responsibility of and be paid for by this subcontractor and shall be approved by the Engineer before execution. Any openings in the building required for the execution of this contract is the responsibility of this subcontractor to coordinate. The number of copies of shop drawings shall be as per the General Conditions of the Specifications.

B. Submittal Procedures and Format

1. Review submittal packages for compliance with Contract Documents and then submit to Engineer for review. Submit transparency and two blue- or black line reproductions of each Shop Drawing larger than 8-1/2 x 11. Submit six sets of each smaller shop drawing. After review, transparency original of each large Shop Drawing and four sets of each small shop drawing will be returned with reviewer's marks.
2. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4" = 1'-0" scale unless specified otherwise. Sheetmetal shop drawings shall be 1/4" = 1'-0" and shall indicate work of other Sections where physical clearances are critical and where interferences are possible. Provide larger scale details as necessary. Sheet metal drawings shall show exposed ductwork, walls, partitions, diffusers, registers, grilles, dampers, sleeves and other aspects of construction as necessary for coordination.
3. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data alone is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

C. Acceptable Manufacturers

1. The Engineer's mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. Alternate acceptable manufacturers are listed below the schedules on the contract documents. No other manufacturers will be acceptable. Alternate manufacturers shall meet the following:
 - a. Meet all performance criteria listed in the schedules and outlined in the specification.
 - b. Have identical operating characteristics to those called for in the specification.
 - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the subcontractor.
 - d. For rooftop mounted equipment and for equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or specifications.
 - e. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.

D. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Engineer.
2. Approval of proposed deviations, if any, will be made at discretion of Engineer.

E. Schedule

1. Incorporate shop drawing review period into construction schedule so that work is not delayed. Subcontractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule. Working days listed reference the time in the Engineer's office. It does not include transmittal or review time of subcontractor or Architect. Allow at least

5 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted.

F. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. Subcontractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the subcontractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.
2. INFORM SUBCONTRACTORS, MANUFACTURERS, SUPPLIERS, ETC. OF SCOPE AND LIMITED NATURE OF REVIEW PROCESS AND ENFORCE COMPLIANCE WITH CONTRACT DOCUMENTS.

G. Resubmission

1. Subcontractor shall make corrections and changes indicated for rejected submissions; resubmit in same manner specified above. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the Owner.

1.8 FEES AND PERMITS

- A. Apply for, obtain and pay for all required permits and inspection certificates.

1.09 EQUIPMENT IDENTIFICATION

- A. Equipment and component parts thereof shall bear manufacturer's nameplates, giving manufacturer's name, size, type model number or serial number, and electrical characteristics, to facilitate maintenance and replacements. Nameplates of distributors or subcontractors are not acceptable. Electrical equipment shall be UL listed as applicable.
- B. All labels and tags shall conform to ANSI/ASME A13.1.
- C. Identify all HVAC equipment including, air handling units, fans, heating devices, etc. with plastic tags. Plastic tags shall be laminated three-layer plastic with engraved black letters on light, contrasting background color. Tag size shall be 1-1/2" square or diameter minimum with 3/8" minimum high text.
- D. Identify gas piping as indicated in specification 63751-23400 "Plumbing."

1.10 RECORD DRAWINGS

- A. The Engineer will furnish the subcontractor one set of AutoCAD 2018 drawing files in AutoCAD 2018 or Revit 2018 format of the mechanical drawings as issued for this contract. Change these drawings to indicate accurately and neatly, any deviation in the actual installation from the Drawings as issued, including work installed as a modification or addition to the original design. Include actual location of existing utilities if they differ from design documents.
- B. Record drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.
- C. THE ENGINEER WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS - THIS IS THE SOLE RESPONSIBILITY OF THE SUBCONTRACTOR.
- D. Each trade shall submit the record set for approval by the building department in a form acceptable to the department, when required by the jurisdiction. Such drawing format size changes, and supplemental information required for the submittal is the requirement of the subcontractor.

1.11 INSTALLATION, OPERATION & MAINTENANCE MANUAL INSTRUCTIONS

- A. Obtain at time of purchase of equipment, three copies of operation, installation and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:
 - 1. Directions for and sequence of operation of each item or mechanical system, e.g. pumps, fans, etc. Sequence shall list valves, switches, and other devices used to start, stop and control system. Detail procedure to be followed in case of malfunctions.
 - 2. Detailed maintenance and troubleshooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of an approved balancing report.
 - 3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.
 - 4. Manufacturer's literature describing each equipment item and containing final approved copies of shop drawings of each item listed.
 - 5. Copy of each automatic control diagram, with respective sequences of operation, consisting of final approval shop drawings, corrected to "as-installed".
 - 6. Manufacturer's installation instructions and detailed parts list for each major equipment item.

7. Complete list of spare parts as recommended by each equipment manufacturer for each item of equipment on the project.
 8. 11x17 scale down set of the as-built documents.
- B. Furnish three copies of manuals to Engineer for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- C. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of various systems. Instructions shall be performed by factory trained personnel. Owner shall determine which systems require additional instructions. Duration of instructions shall take equipment through complete cycle of operation. Make adjustments under operating conditions.

1.12 PROTECTION OF EQUIPMENT, MATERIALS & PREMISES

- A. Each subcontractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.
- B. Each separate subcontractor shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.
- C. All floors, walls, ceilings and furniture shall be properly protected from damage by this subcontractor during the installation via plywood and/or plastic covering. Relocation of furniture shall not be done without the approval from the Owner. Any damage caused by the installation shall be remedied by this sub-contractor at no additional cost to the owner.

1.13 INSTRUCTION TO OWNER'S PERSONNEL

- A. After completion of work and tests, the subcontractor shall provide necessary skilled personnel to operate the entire installation for a total period of one 8-hour day. During the operating period the subcontractor shall fully instruct the Owner's representative in the complete operation, adjustment, and maintenance of the entire installation.

1.14 SELECTION AND ORDERING OF MATERIALS

- A. General
1. Arrange for purchase and delivery of materials and equipment required in ample quantities and at proper time. Immediately notify the Architect/Engineer of any inability to obtain suitable delivery of any apparatus or materials required.

- B. Products
 - 1. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
 - 2. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
 - 3. Provide interchangeable components of the same manufacturer, for similar components.
- C. Transportation and Handling
 - 1. Transport and handle products in accordance with manufacturer's instructions.
 - 2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
 - 3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement or damage.
- D. Storage and Protection
 - 1. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
 - 2. For exterior storage of products, place on sloped supports, above ground.
 - 3. Provide off-site storage and protection when site does not permit on-site storage or protection.
 - 4. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
 - 5. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

2.0 PRODUCTS

2.1 MATERIALS

- A. All materials, except as otherwise specified, shall be new, of current production, first quality, and the best of each class specified.
- B. Required materials not covered by the detailed specifications shall be of a suitable class, grade, and type and shall be subject to the approval of the Engineer. Where two or more units of the same class of equipment are required, these units shall be the products of a

single manufacturer. All equipment and materials shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

2.2 SLEEVES

- A. Provide sleeves in locations where pipes or conduits pass through floors, walls, partitions, structural members and roof. Do not make openings which impair strength, function or esthetics of the work. Notify Construction Manager/Engineer prior to any cutting work. Coordinate responsibilities with structural. Refer to 39310-15500 "HVAC Piping" for additional information.

2.3 ACCESS PANELS

- A. Do not place products requiring regular maintenance including valves, traps, controls, unions, dampers, coils, air distribution boxes, actuators, cleanouts at locations that will be inaccessible after construction is completed. Maintain accessibility for all components in systems.
- B. Provide access doors complying with architectural specifications for items concealed above finished ceilings, behind finished walls or floors.
- C. Unless specified in architectural specifications, provide access doors of following sizes: 12 x 12 inches for readily accessible equipment, 18 x 18 inches where partial body access is required and 24 x 24 inches where entire body access is required.
- D. Locate access panels for walls, ceilings and floors at locations indicated on drawings or as required to permit access for adjustment, removal and replacement, and servicing of all concealed HVAC equipment.
- E. All access panels shall be located in a workmanlike manner, generally in closets, storage rooms and other non-public areas, positioned so that the equipment can be easily reached, and the size shall be sufficient for this purpose (minimum 14" x 14"). When access panels are required in corridors, lobby or other habitable areas, they will be located as directed by the Engineer.

2.4 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Furnish and install all supplementary steel and structural supports required for the proper installation, mounting and support of all equipment.
- B. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Engineer, as specified.
- C. The type and size of the supporting steel shall be determined by the installer and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements.

- D. All supplementary steel shall be installed in a neat and workmanlike manner parallel to the walls, floor and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.
- E. All supplementary steel supports and fitting shall be galvanized structural steel or galvanized roll formed steel as manufactured by Unistrut, Power-Strut, or approved equal.

3.0 EXECUTION

3.1 PREPARATION

- A. Arrangements shall be made to have the openings, inserts, sleeves and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If cutting becomes necessary for installation of the work, it shall be done under this Section. All holes shall be neatly patched and approved by the Engineer. All cutting shall be performed in a manner approved by the Engineer. All cutting shall be performed in a manner not to weaken the structural parts and in the manner and method which shall meet the approval of the Engineer and code.

3.2 WORKMANSHIP

- A. All work shall be coordinated with the work to be performed or installed under other Sections of these Specifications.
- B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.
- C. Where required to avoid interference with other work, to increase headroom, or to improve the appearance of duct runs, offsets shall be provided as required. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this Section.
- D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.
- E. This subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.3 ERECTION AND INSTALLATION

- A. Installation and workmanship requirements are specified hereinafter.
- B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all mechanical equipment specified herein.
- C. Provide all transportation, freight, loading, and unloading, and provide all labor necessary for erecting in place all material and equipment shown, specified or required for completion of the HVAC work.

- D. The work shall be performed in a timely manner so as to cause no delay in job progress. Cooperate with the other phases of construction so that the work is installed in the most beneficial sequence for proper project completion.
- E. Install all work so that all parts required are readily accessible for inspections, operation, maintenance, and repair. Minor deviations from the drawings may be made for this purpose, but changes of magnitude shall not be made without prior written approval of the Engineer.

3.4 CLEANING OF SYSTEMS AND PREMISES

- A. Before the systems are tested and balanced, ducts and all air handling equipment shall be thoroughly cleaned so that no dirt, dust, or other foreign matter will be deposited in or carried through the systems.
- B. At all times, keep the premises clear of undue accumulation of rubbish.
- C. On completion of each day's work, remove all rubbish and debris resulting from this contract, and dispose of same. At any time should the Construction Manager/Owner be dissatisfied with the performance of clean-up responsibilities, he may elect, after proper notification, to undertake this operation and charge this subcontractor accordingly.
- D. Air ducts shall be protected after fabrication and in shipment, prior to construction. Openings shall be suitably closed to prevent the admission of dust and construction debris. The protection shall be a minimum of 10 mil reinforced plastic and shall be removed only by the subcontractor installing the ductwork system.
- E. The work of each section includes removing tools, providing daily clean-up of work area, scaffolding, surplus materials, barricades, temporary walks, debris and rubbish from the project promptly upon completion of that portion of the work. Leave the area of work clean and free of these items.
- F. Disconnect, clean and whenever necessary, remove obstructions from any system and reconnect system. Repair or replace work damaged in the course of removing obstructions, at no cost to Owner.
- G. Protect all finished work against physical damage during the course of construction and until completion and acceptance by Owner.
- H. During construction, cap all lines and equipment so as to prevent the entrance of debris and dirt. Protect against moisture, plaster, cement, paint and other work by covering the polyethylene sheets.

3.5 FIRESTOPPING

- A. Firestopping: unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.
 - 1. Firestopping material shall be UL listed and tested silicone elastomer specifically formulated for use in horizontal and vertical applications. The material shall possess intumescent characteristics; upon exposure to heat above 250° F shall expand to not

less than five times its original volume to form a fireproof envelope UL rated for 2- and 3-hour protection, when applied in accordance with the manufacturer's recommendation.

2. Floor slots and openings shall be closed with 16 gauge galvanized steel sheet supported on 1-inch by 1-inch by 1/8-inch structural angle drilled or supported with powder-driven studs into the building structure. Firestop with a layer of silicone elastomer not less than 1-inch thick which completely fills the opening. The top surface of the silicone elastomer shall be approximately 1-inch below the finished floor slab.
 3. Openings in walls shall be closed with 16 gauge galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/8-inch thick layer of non-sagging silicone elastomer to fully cover the opening.
 4. Single or multiple pipes passing through walls and floors shall have the annular space between pipes or between pipes and structure filled with silicone elastomer to provide a 3-hour rated firestop for floors and walls.
- B. Pipe and Ducts: The annulus between exposed pipe and ductwork and walls or floors in finished spaces shall be filled, sealed, and painted to match adjacent surfaces.
- C. Future Slots: Identify unused sleeves and slots for future use by permanently anchored brass nameplates identifying size and purpose of the covered slot.

3.6 START UP AND TESTING

- A. General
1. Completion of start up and commissioning is a prerequisite for substantial completion.
 2. Operate and maintain systems and equipment until final acceptance by the Owner.
 3. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum, complete systems commissioning.
 4. HVAC systems shall be commissioned by an agent hired by the owner. The Mechanical Contractor shall carry the cost to assist the agent in this process.
- B. Comprehensive Work Plan
1. Provide detailed, methodical, scheduled start up, and commissioning procedures and execution of same for every system and piece of equipment provided.

2. Develop and submit for approval a specific start up check out and sign off form for each and every system.
3. Systems shall be operated under actual or stimulated full load conditions. Identify the operating conditions in the work plan.
4. Do not cover or conceal work before testing and inspection and obtaining approval.
5. Leaks, damage and defects discovered or resulting from startup and testing shall be repaired or replaced by this contract to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.
6. For each piece of equipment, copy nameplate data and include in report.

3.7 MAINTENANCE

- A. Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.
- B. Subcontractor shall be responsible for cleaning air handling equipment. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

3.8 SPECIAL RESPONSIBILITIES

- A. Cooperate and coordinate with work of other Sections in executing work of this Section.
 1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.
 2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
 3. Obtain detailed installation information from manufacturers of equipment provided under this Section.
 4. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by Owner.
 5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance.

3.9 MATERIALS AND WORKMANSHIP

- A. Work shall be neat and rectilinear. Install material and equipment as required by manufacturers. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and

pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

- B. References to manufacturers and to catalog designation are intended to establish standards of quality for materials and performance but imply no further limitation of competitive bidding.
- C. Finish of materials, components and equipment shall be as approved by Engineer and shall be resistant to corrosion and weather as necessary.

3.10 PAINTING

- A. Paint unpainted, non-insulated, non-galvanic, ferrous metal surfaces of pipes, equipment fixtures, hangers, supports and accessories in accordance with project requirements and specifications.

3.11 CUTTING AND PATCHING

- A. Do not cut existing construction without prior approval of Construction Manager/Engineer.
- B. Provide sleeves, caps, plates, escutcheons, flashing and similar materials required to fill or close openings. Provide final grouting, finish and other materials as required. Make repairs in like and kind to ensure exact patching of surfaces and finishes.

3.12 EQUIPMENT BASES AND SUPPORT

- A. Unless otherwise indicated on structural drawings, provide housekeeping pads of concrete, minimum four inches thick, extending six inches beyond equipment supported.
- B. Provide templates and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or steel pipe and fittings. Brace and Fasten with flanges bolted to surface.

3.13 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors and roofs.
- B. Provide curbs for mechanical roof installations. Flash, counterflash and install per details on drawings and specifications.

3.14 PREPARATION FOR TESTING, ADJUSTING AND BALANCING

- A. Mechanical Installer shall:
 - 1. Review Contract Documents and all submittals to verify that piping, instruments, thermowells, valves, ductwork, dampers, measurement and control devices, and access openings have been provided in correct quantity and at correct locations to

permit testing and balancing of air, steam and hydronic systems under various operating conditions.

2. Provide V-belt drives, variable frequency drives, initial fixed pitch sheaves or variable pitch sheaves for fans as indicated. Replace variable pitch sheaves or initial fixed pitch sheaves with appropriate fixed pitch sheaves when correct speed (rpm) has been determined by Balancing Subcontractor. Delivery variable pitch sheaves and initial fixed pitch sheaves to the Construction Manager. Notify the Balancing Subcontractor upon completion of sheave replacement.
3. Inform the Balancing Subcontractor regarding major deviations from Contract Documents made to systems during construction and furnish one (1) complete set of Record Drawings, showing presence and location of balancing elements, volume dampers and instrument ports, prior to start of TAB work.
4. Provide indicated Work and submit certification that each operation indicated is complete and in accordance with Contract Documents. This Work must be accomplished before TAB work can start. Within 30 days of notification by Owner of award of Testing and Balancing Contract, submit schedule to complete following Work:
 - a. Complete physical installation.
 - b. Pressure test air, steam and hydronic systems as required.
 - c. Clean, flush, fill and chemically treat steam and hydronic systems as required. Provide temporary startup strainers and replace with clean strainers after system cleaning as indicated.
 - d. Provide each air system with start-up filters. Replace filters during construction as required by Construction Manager. Replace with new specified filters upon acceptance of each system by Owner.
 - e. Test and operate prime movers, including fans, chillers and pumps at full design load to verify adequate power, proper rotation, completed controls, operational auxiliaries, and complete overall installation.
 - f. Balance rotating equipment statically and dynamically.
 - g. Secure linkages.
 - h. Properly evacuate air from liquid systems. Install air vents at coils and at all high points in systems whether or not expressly indicated, and verify that they operate properly. Verify that expansion tanks are filled, at correct pressure and in proper working order.
 - i. Verify that automatic control valves are in proper working order and location that they are marked and installed with correct "NORMAL" positions as required, and that hand valves and balancing valves are positioned for full flow through equipment.

- j. Verify that automatic control dampers are in proper working order and location, that they are marked and installed with correct NORMAL positions as required. Verify that balancing and shut-off dampers are positioned for full flow. Verify that equipment, terminal devices and distribution systems are completely and properly connected.
5. For each item of mechanical equipment, furnish to the Balancing Subcontractor data sheets and submittals indicating operating temperature, pressure, flow rate, amperage, voltage, phase, frequency (Hz), rpm and brake horsepower, as appropriate.
6. Deliver to the Balancing Subcontractor, for use until TAB work is complete, flow-indicating devices intended for use with permanently installed primary flow measuring devices. Calibrate permanently installed flow measuring devices and associated display instruments, thermometers, sensors and pressure gauges. Deliver documentation to the Balancing Subcontractor to verify calibrations.
7. Submit schedule stating when each system is ready for TAB work to begin to Construction Manager.
8. Attend all scheduled project coordination meetings with the Balancing Subcontractor. These meetings will be conducted under guidance of the Construction Manager.
9. Provide labor, material, tools and equipment to operate mechanical equipment and systems during TAB work, and for required adjustments, calibrations and repairs of automatic control devices or their components. Provide these services on each working day and without undue delay, as required by the Balancing Subcontractor. Protect and operate equipment and systems during TAB work.
10. When requested by the Balancing Subcontractor, furnish services of personnel to accompany the Balancing Subcontractor when TAB work is being performed.
11. Make modifications at no additional cost and to satisfaction of Owner's Representative to rectify discrepancies reported by the Balancing Subcontractor indicating non-compliance with Contract Documents.

3.15 PROJECT CLOSE OUT

A. General

1. It shall be each subcontractor's responsibility to personally hand-deliver all of the required project close-out checklist items and to obtain owner's authorized representative(s) signed receipt on all items requiring owner sign-off.

B. Project Close-Out Checklist

1. Review requirements of each section of the specifications and submit for approval to Engineer the sign-off forms which shall become the project close-out checklist. These at a minimum shall include the following information shown in attached Project Closeout Checklist Example. The Owner may incorporate additional specific items to the following checklist which shall become part of the project requirements

2. Close-Out Checklist Example

PROJECT:			
DIVISION NO.:			
SUBCONTRACTOR:			
ITEM ¹	DATES		OWNER'S SIGN-OFF
	COMPLETED	RECEIVED BY OWNER	
Permits			
City and County Inspection			
Manufacturers Warranties			
Contractors Warranties			
State Fire Rating Data			
Copy of Final Shop Drawings			
List and Possession of Spare Parts			
Pressure Tests			
Equipment Tests Required by Specs			
O & M Manuals			
Record Documents			
Coordination Drawings			
Commissioning Reports/Letters			
On Site Training Complete			
Final ATC Installation Drawings			
Insurance Underwriters Approvals			
Final Punch List (Initialed by subcontractor that items are complete)			
Building Certificate of Occupancy (CO)			

¹ Provide separate line item for each specified item (do not group items).

++ END OF SECTION 230000 ++

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1.0 GENERAL

- A. The information contained in this specification shall be considered confidential. This specification shall be used only for its intended purpose in conjunction with the project for which it has been prepared.

1.2 SCOPE OF WORK

- A. Perform work and provide all permits, transportation, freight, materials, appurtenances, machinery, equipment, tools, loading, unloading, sleeving, core-drilling, testing, labeling, labor and supervision necessary, as shown on the drawings and as specified to install, complete, and make ready for continuous operation, the natural gas system specified herein.
- B. The plumbing systems shall include, but not be limited to, the following:
 - 1. Above ground natural gas piping systems complete with fittings, joining materials, supports, and appurtenances.

1.3 CODES AND STANDARDS

- A. The plumbing systems shall be installed in conformance with the governing codes, regulations, local ordinances, and authorities having jurisdiction.
- B. File drawings, pay fees, and obtain permits and certificates of inspection relative to the work. Arrange for inspections with the proper authorities having jurisdiction and include the costs of the permits and inspections in his package and shall schedule such inspections, giving the Construction Manager a minimum of 48 hours advance notice such that the inspections may be witnessed.
- C. If the code or other requirements exceed the provisions indicated in the Contract Documents, notify the Construction Manager in writing. Where the work indicated on the Contract Documents exceeds code requirements, the installation shall be done in accordance with the Contract Documents. Work done contrary to these requirements shall be removed and replaced at the expense of the responsible Contractor.
- D. The plumbing layout, workmanship, methods, piping, systems, equipment, and appurtenances shall meet the highest standards of the trade and shall conform to the latest editions with amendments of the following associations:
 - 1. Rhode Island State Plumbing and Gas Codes with applicable amendments.
 - 2. Requirements of the City of Pawtucket applicable local codes, and the local authorities having jurisdiction.
 - 3. American Society of Plumbing Engineers (ASPE) data books.
 - 4. Plumbing Industry Standards.
 - 5. American Society of Mechanical Engineers (ASME).

6. American National Standards Institute (ANSI).
7. American Society for Testing Materials (ASTM).
8. Nation Fire Protection Association Gas Code (NFPA 54).
9. National Bureau of Standards (NBS).
10. The Narragansett Bay Commission (NBC).
11. Occupational Safety and Health Act (OSHA).
12. The Owner's Internal Safety Program.
13. The manufacturer's recommendations for piping, venting and wiring.
14. Underwriters' Laboratories (UL).

1.4 QUALITY ASSURANCE

- A. For each product specified, provide components by same manufacturer throughout.
- B. For each product and systems specified, provide domestic components (non-foreign), acceptable by state standards and approvals throughout.
- C. Materials shall be delivered in non-broken, factory-furnished packaging and stored in a clean, dry indoor space that provides protection against the weather.
- D. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of plumbing work.
- E. Testing of the systems shall be completed, inspected, and approved by the Owner's Representative before insulation is applied.
- F. References to manufacturers and catalog designations are intended to establish standards of quality for performance and materials but imply no further limitation of competitive bidding.
- G. Materials shall be labeled with manufacturer's pertinent information, delivered in non-broken, factory-furnished packaging, and stored in a clean, dry indoor space that provides protection against the weather.
- H. Provide all domestic piping components (non-foreign), acceptable by state standards, approvals throughout and Engineer of Record.

1.4 QUALIFICATION OF WELDING

- A. Qualifications of the welding procedures to be used and the performance of welders and welding operators shall be in accordance with ASME B31.9 except as follows:
 1. Copies of the applicable welding procedure specifications including the Procedure Qualifications Records (PQR), along with the welder/welding operator qualification test records and certificates, shall be submitted by the Contractor to Engineer of record at

least (5) business days prior to performing any welding work.

2. Welder and welding operator performance qualification from other employees is not acceptable.
- B. The Owner's representative shall be notified 24 hours in advance of tests.
 - C. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record as for indication of their work only. No code welding, ASME inspection, or x-ray of welds is required.
 - D. A fire watchman with an approved fire extinguisher shall be posted at the site of the welding work, during that work, and for a minimum of 30 minutes after the work is completed, to see that sparks or drops of hot metal to cause a fire.
 - E. Plumbing Contractors shall have not less than (5) five years experience as a Plumbing Contractor with specific experience in piping fabrication techniques, application and installation of the material types and sizes as referenced herein, and as shown on the engineering drawings and/or as referenced in the bid documents. Any materials the Contractor has not had specific working experience with shall be made known to The Engineer of Record with the submittal of the bid documents. The Owner reserves the right to verify all Contractors' qualifications, or to require that the Contractor provide specific work experience documentation.
 - F. All plumbing pipe fitters shall be licensed in the State of R.I. and all welders shall have welding certificates. This shall be required for all installers and given to the Engineer Of Record before any work is performed. The welds will be inspected by the Engineer to ensure quality. The installing contractor will be responsible for any defects or imperfections found in the welds and will be responsible for any cost to repair or redo the welds to the Engineers' satisfaction.

1.5 WELDING REQUIREMENTS

- A. All welds in pressure piping (and all welds to pressure piping for structural attachments) shall be in accordance with ASME B31.9 and the following:
 1. The weld at the perimeter of branch connection reinforcing pads shall be a continuous full fillet weld unless otherwise approved by the Owner or Owner's Representative.
 2. Ends of valves and unions of socket welding construction shall be welded by an electric arc process to minimize distortion.
 3. Valves shall be closed during welding.
 4. Non-metallic valve seats shall be removed during welding unless otherwise stated in the manufacturer's literature.
 5. Welding on piping systems shall be performed using the Shielded Metal Arc Welding (SMAW) process, Gas Tungsten Arc Welding (GTAW) process, Gas Metal Arc Welding (GMAW) process and/or the Flux Cored Arc Welding (FCAW) process may be used.
 6. The Submerged Arc Welding (SAW) process may be used in the shop for automatic

machine welding operations .

7. The weld procedure and welder qualification shall specify which process will be used on what piping and/or support system for approval by the Engineer of Record.

B. General

1. As a general rule, the width of the weld puddle should be about twice the thickness of the metal being welded.
2. Where insert flanges are being used, the insert shall be attached using two separate welds. Four stitch welds, with a total length equal to one-half the pipe circumference, are to be made between the back of the insert and the outside of the pipe. This will provide strength while indicating if the seal weld is leaking. Filler wire is to be added only when necessary. A face or seal weld shall be made between the end of the pipe and the interior of the insert. The insert face shall be extended 1/8" beyond the end of the pipe. None of the grooves on the inside of the insert are to be exposed.
3. If valves which contain heat-sensitive parts, such as plastic or rubber, are being welded into the system, these parts are to be removed during welding to prevent heat damage. Heat sinks must be used for welding valves where recommended by the valve manufacturer and in the manner prescribed.
4. The welder shall strive to minimize the Heat Affected Zone (HAZ) by controlling heat (amperage) input, technique and cooling. No more heat than is necessary for full penetration should be used; in other words, the amperage should be kept as low as possible and still melt the inside edge of the pipe wall.

C. SMA Welding

1. Welding equipment shall be inverter type, of a size and type suitable for the work and shall be maintained in such a condition as to ensure acceptable welds by direct, reverse or alternating current.
2. SMA welding shall be direct current, reverse polarity.

D. TIG Welding

1. Welding equipment shall be of a size and type suitable for the work and shall be maintained in such a condition as to ensure acceptable welds.
2. Electrodes shall be 1/16" or 3/32" diameter, 2% thoriated tungsten conforming to AWS-ASTM, EWTh2 classification. They are to be sharpened to a pencil point with a fine abrasive wheel and re-sharpened often enough to keep them clean. Tungsten should be held parallel to the direction of rotation of the grinding wheel. Filler wire must be stored in a dry location until ready for consumption.
3. The electric current for welding shall be direct current, straight polarity (electrode negative). For wall thicknesses up to and including 0.083 inches, the suggested settings are 12 to 14 volts and 30 to 40 amperes. These may be varied somewhat according to the welder's capabilities, but any value chosen must be within the recommended range as provided by the electrode manufacturer and produce welds of acceptable quality.

4. Automatic welding is preferred for all shop welds.

1.5 EXAMINATION OF PREMISES

- A. Prior to the ordering or purchasing plumbing equipment and materials, or the layout or installation of work, examine the premises and verify the existing conditions. Report in writing to the Construction Manager unsuitable conditions which might adversely affect this Contractor's work.
- B. Work involved with existing equipment or services, model numbers, sizes, and electrical characteristics shall first be verified to be compatible with the new work and equipment shown on the drawings.
- C. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.6 USE OF PREMISES

- A. Confine apparatus, storage of materials, and construction operations as directed by the Construction Manager and do not encumber the premises with materials.
- B. Enforce instructions of the Owner and Construction Manager regarding safety, signs, advertisements, fires, danger signals, barricades, and smoking, and require persons employed to comply with facility or institutional regulations while on the premises.
- C. Conduct work so as not to interfere with the functioning of existing services.

1.7 INTERPRETATION OF DRAWINGS

- A. The drawings convey the general arrangement of the systems, scope of work, and function of systems.
- B. The exact arrangement and location of piping and equipment shall be determined from shop drawings and accurate, field-coordinated measurements and conditions.
- C. The exact locations to secure the conditions and project results shall be determined at the project site with written approval from the Construction Manager before proceeding with the installation.
- D. Follow the drawings in laying out the work and checking the drawings of other trades to verify spaces in which the plumbing work is to be installed. Maintain maximum headroom and space conditions at points. Where headroom or space conditions appear inadequate, notify the Construction Manager before proceeding with the installation.

1.8 LIABILITY OF CONTRACTOR

- A. This Contractor shall have sole charge and possession of the work covered by his Contract, except as otherwise specified, until it is completed and accepted by the Owner and Construction

Manager and he shall hold the Owner and Construction Manager harmless and protect them against suits of any kind brought against them or on account of any liens for labor performed or material provided.

- B. This Contractor shall be responsible for any consequences arising from carelessness, negligence, or dishonesty of those in his employ.
- C. Make good on improper work and materials and hold the plumbing engineer/designer of record free from any and claims, whatsoever in nature, arising during the erection and completion of this work.

1.9 COMPLETENESS OF WORK

- A. The omission from the plans and specifications of expressed references to any reasonable labor or materials necessary for the proper executing or completion of the work, shall not relieve this Contractor from furnishing them in keeping with the basic character and intent of the work.

1.10 WORK PERSONNEL

- A. Furnish first-class skilled workmen for work, and shall keep a competent foreman or superintendent on premises at times during the progress of the work that shall have the authority to act for and in behalf of this Contractor during the latter's absence with regard to directions given to him by the Construction Manager.
- B. All careless or incompetent personnel shall be removed forthwith by this Contractor when he is notified to do so by the Construction Manager or his authorized representative.
- C. All personnel working in the facility will be subject to a background check and be inputted into their system per their Vendor policies. No personnel will be allowed to work on the premises without passing a background check.

1.11 SAFETY PRECAUTIONS

- A. Comply with of the safety requirements of OSHA and the Owner's Internal Safety Program throughout the entire period of construction.
- B. Provide and maintain proper guards for prevention of accidents and to secure safety of life and property.
- C. Comply with the Owner's sign-in/sign-out programs that may apply.

1.12 WORKMANSHIP

- A. Provide a neat workable installation utilizing good craftsmanship. The work shall be executed as rapidly as possible.
- B. All piping shall be run in the most direct, straight and mechanical manner.
- C. The decision of the Construction Manager as to the character of any labor provided shall be final and conclusive on both this Contractor and the Owner.

1.13 PROTECTION OF WORK AND PROPERTY

- A. Care and protect work included under this section until it has been tested and accepted.
- B. All pipe openings shall be temporarily closed so as to prevent obstruction damage.
- C. Protect equipment and materials from damage from causes including weather, water, frost, accident and theft. Materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.
- D. Protect outlets and openings with temporary plugs, caps and covers. Protect work and materials AND other trades from damage that might be caused by work or workmen and make good damage thus caused.
- E. Care for tools, equipment and materials, and their safekeeping at all times.
- F. Replace stolen, lost, or damaged items relative to the installation and operation of the plumbing systems before the facility is accepted.

1.14 ACCESSIBILITY

- A. Install plumbing systems work so that parts shall be readily accessible for inspections, operation, maintenance, and repair.
- B. Minor deviations from the drawings may be made for this purpose, but changes of magnitude shall not be made without prior written approval of the Construction Manager.

1.15 TESTING AND ADJUSTING

- A. Inspect work and make adjustments and corrections in order to provide a complete, first-class working system.
- B. Test new (and existing systems connected to) and make adjustments and corrections to provide a complete, first-class working system.
- C. Provide labor, materials, and instruments necessary for completion of tests under observation of the local authorities and the designated inspectors.
- D. Make adjustments and place piping systems in operation and demonstrate the proper functions of the piping systems, equipment, and controls.

1.16 CERTIFICATES OF APPROVAL

- A. Upon completion of work and after the necessary periodic inspections have been made by the authorities having jurisdiction, copies of inspection reports and approvals shall be forwarded to the Construction Manager by this Contractor within seven (7) – ten (10) working days.

1.17 GUARANTEE

- A. Manufacturers shall provide their standard warranties for materials and equipment furnished under this section. Such warranties shall be in addition to and not in lieu of liabilities which the manufacturer and Contractor may have by law or by provisions of the Contract Documents. It shall be the responsibility of this Contractor to obtain from the piping and equipment manufacturers written guarantees covering their respective equipment for the above period of time.
- B. All materials, equipment and work provided under this project as a whole shall be guaranteed, by this Contractor, against defects in materials and workmanship for a period of one (1) year (or as delineated in Division I, whichever is greater in time) commencing with the date of the final written acceptance by the plumbing engineer/designer of record. Failure due to defective material, equipment or workmanship which develops shall be corrected by this Contractor at no expense to the Owner including damage(s) to the areas, materials and other systems resulting from such failures (replacing adjacent insulation and jacketing, etc.).
- C. Upon receipt of notice from the Owner of failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.
- D. If any part of a system should be stopped by foreign matter being placed in the systems, disconnect the system, clean, and reconnect wherever necessary to locate and remove obstructions. Repair or replace any work damaged in the course of removing obstructions.
- E. The terms "foreign matter being placed in the systems" and "repair or replace any work damaged in the course of removing obstructions" shall be understood to mean any new debris which under normal conditions, is not conducive to and/or necessary for the proper operation of the plumbing systems.
- F. Under no circumstance will the one (1) guarantee commence until this Contractor's contractual obligations to the Owner have been fulfilled in their entirety (i.e. purchase, installation, cleaning, testing, start-up, balancing, commissioning, etc.).
- G. The system will not be accepted until this Contractor proves to the Owner, Construction Manager, and plumbing engineer/designer of record that they are code-complaint and operating as designed pursuant to the contract documents; that this Contractor's project manager has personally verified that all punch list items have been properly addressed as written; and that the plumbing systems are commissioned with the report approved by the plumbing engineer/designer of record.

1.19 CLEAN UP AND REMOVAL OF RUBBISH

- A. This Contractor shall keep the facility and site clean from the accumulation of rubbish and waste materials and, upon completion, leave the facility, the site and the installation in a clean condition, completely acceptable to the Owner.
- B. At the completion of the work, this Contractor shall remove from all tools, scaffolding, temporary bracing, cross ties and a like, debris, waste and unused materials from and about the premises.

- C. All items shall be secured and in their final positions and shall present a neat and workmanlike appearance.
- D. All temporary bracing, cross ties and a like shall be removed.
- E. All stains and/or damage done to the finish of the project areas that is caused by faulty workmanship and/or improper handling of materials regarding this installation shall be cleaned or removed and replaced, in accordance with the Owner's requirements.

1.20 SHOP DRAWINGS AND SUBMITTALS

- A. General
 - 1. Shop Drawings are information prepared by the subcontractor to illustrate portions of the work in more detail than shown in the Contract Documents.
 - a. Accompany submittal with transmittal letter containing project name, subcontractor's name, number of samples or drawings, titles, and other pertinent data. Outline deviations, if any, in submittals from requirements of Contract Documents.
 - 2. Each individual submittal item shall be marked to show the specifications section and paragraph number which pertains to the item.
 - 3. Shop drawings shall include printed catalogue specifications and printed capacity data to enable confirmation of capacities and specifications which may be shown on certified prints. Where catalogues or data submitted are applicable to several different sizes or types of similar equipment, the vendor shall clearly indicate which piece of equipment or material is to be provided under this contract. If the submittal is not properly marked it will be returned NOT APPROVED.
 - 4. If the subcontractor fails to submit properly marked, complete and prudently timed, shop drawings and thus, causing delays in re-submittal or project schedules, it is the subcontractor's responsibility to do whatever is necessary to meet schedules at no additional cost to the Owner.
 - 5. Shop drawings, catalogue specification data and capacity ratings of the following items shall be submitted to the Engineer for approval prior to purchase or installation of any work:
 - a. All equipment scheduled on the drawings. Submittals shall contain, as a minimum, all performance data as listed on schedules so that the Engineer can easily compare manufacturer's data. Submittals not meeting these criteria shall be disapproved.
 - b. As specified in other Division 15 Sections.
 - 6. Engineer's review of shop drawings is for general conformance with the design concept and contract documents. Marking or comments shall not be construed as relieving the subcontractor from compliance with the project plans and specifications, nor departures there from. The subcontractor remains responsible for details and accuracy.

7. This subcontractor is responsible for the dimensions and arrangement of equipment as it is applied to this project. Any adaptation, modification, or additions is the responsibility of and be paid for by this subcontractor and shall be approved by the Engineer before execution. Any openings in the building required for the execution of this contract is the responsibility of this subcontractor to coordinate. The number of copies of shop drawings shall be as per the General Conditions of the Specifications.

B. Submittal Procedures and Format

1. Review submittal packages for compliance with Contract Documents and then submit to Engineer for review. Submit transparency and two blue- or black line reproductions of each Shop Drawing larger than 8-1/2 x 11. Submit six sets of each smaller shop drawing. After review, transparency original of each large Shop Drawing and four sets of each small shop drawing will be returned with reviewer's marks.
2. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4" = 1'-0" scale unless specified otherwise. Sheetmetal shop drawings shall be 1/4" = 1'-0" and shall indicate work of other Sections where physical clearances are critical and where interferences are possible. Provide larger scale details as necessary. Sheet metal drawings shall show exposed ductwork, walls, partitions, diffusers, registers, grilles, dampers, sleeves and other aspects of construction as necessary for coordination.
3. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data alone is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

C. Acceptable Manufacturers

1. The Engineer's mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. Alternate acceptable manufacturers are listed below the schedules on the contract documents. No other manufacturers will be acceptable. Alternate manufacturers shall meet the following:
 - a. Meet all performance criteria listed in the schedules and outlined in the specification.
 - b. Have identical operating characteristics to those called for in the specification.
 - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the subcontractor.

- d. For rooftop mounted equipment and for equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or specifications.
- e. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.

D. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Engineer.
2. Approval of proposed deviations, if any, will be made at discretion of Engineer.

E. Schedule

1. Incorporate shop drawing review period into construction schedule so that work is not delayed. Subcontractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule. Working days listed reference the time in the Engineer's office. It does not include transmittal or review time of subcontractor or Architect. Allow at least 5 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted.

F. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. Subcontractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the subcontractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.
2. **INFORM SUBCONTRACTORS, MANUFACTURERS, SUPPLIERS, ETC. OF SCOPE AND LIMITED NATURE OF REVIEW PROCESS AND ENFORCE COMPLIANCE WITH CONTRACT DOCUMENTS.**

G. Resubmission

1. Subcontractor shall make corrections and changes indicated for rejected submissions; resubmit in same manner specified above. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the Owner.

1.20 RECORD DRAWINGS

- A. The Engineer will furnish the subcontractor one set of AutoCAD 2010 drawing files in AutoCAD 2007 format of the mechanical drawings as issued for this contract. Change these drawings to indicate accurately and neatly, any deviation in the actual installation from the Drawings as issued, including work installed as a modification or addition to the original design. Include actual location of existing utilities if they differ from design documents.
- B. Record drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.
- C. THE ENGINEER WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS - THIS IS THE SOLE RESPONSIBILITY OF THE SUBCONTRACTOR.
- D. Each trade shall submit the record set for approval by the building department in a form acceptable to the department, when required by the jurisdiction. Such drawing format size changes, and supplemental information required for the submittal is the requirement of the subcontractor.

2.0 PRODUCTS

2.1 MATERIALS

- A. All materials shall conform to the requirements of the Local and Federal Codes and Standards, Federal specifications and standards listed as commercial, ASTM, and the requirements specifically stipulated herein.
- B. Use only firestopping products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type or joint opening width and movement capabilities, annular space requirements, and fire-rating involved for each separate instance.
- C. Each length of pipe, fitting, piece of material and/or device used in the plumbing piping systems shall have stamped or indelibly marked on it the manufacturer's name or mark, type, schedule and applicable ASTM/ASME standard number.

2.2 NATURAL GAS PIPING, ABOVE GRADE

A. NG

MATERIAL: Carbon Steel (ANSI 150# R.F.)
PRESSURE: Range 1 to 5 psig
TEMPERATURE: Range 32°F to 100°F

Item	Size	Description	Remarks
Pipe	1/2" thru 2"	Carbon steel Schedule 40 ASTM A-106 Grade B seamless threaded & coupled ANSI B36.10	
	2-1/2" thru 16"	Carbon steel standard weight ASTM A-106 Grade B seamless beveled ends ANSI B36.10	
Type of Joint	1/2" thru 2"	Screwed NPT	
	2-1/2" thru 16"	Butt welded	
Fittings	1/2" thru 2"	Malleable iron ASTM-A-197 300# ANSI B16.3 screwed ends black.	
	2-1/2" thru 16"	Carbon steel ASTM A-234 WPB standard weight ANSI B16.9	
Nipples	1/2" thru 2"	Carbon steel ASTM A-106 Grade B Schedule 80 threaded both ends	
Unions	1/2" thru 2"	Malleable iron, 300# class, ASTM A197 Bronze to iron seats.	Note 3
Flanges	1/2" thru 2"	Screwed forged steel ANSI 150# class ASTM A-105 raised face ANSI B16.5.	
	2-1/2" thru 16"	Weld neck forged steel ANSI 150# class ASTM A-105 standard bore raised face ANSI B16.5	
		Exception: Use flat face flanges when mating with flat faced flanges on valves or equipment.	
Gaskets	1/2" thru 16"	11/8" ring gasket Type 316 SS spiral wound Approved Gaskets: Flexitallic style CG with super Flexite filler (Use FF gaskets with FF flanges)	Note 2
Thread Sealant		Teflon ribbon 1/2" wide X 4 mils thick.	
Bolts		Machine Bolts- Carbon Steel ASTM A-307 Grade B; Thread ANSI B1.1 Class 2A; Heavy Hex Nuts- Carbon steel ASTM A-563 Grade A; Thread ANSI B1.1 Class 2B	Note 3
		Exception: Use cadmium plated bolts & nuts for outdoor installations	

B. For exterior above grade use, provide piping with three-layer coating of factory-applied epoxy or field-applied primer and three coats of epoxy paint on all piping and fittings. Field coating shall be manufactured by Amercoat Type 240 or approved substitute, and shall be applied in accordance with manufacturer's recommendations. Color shall be gray.

2.3 NATURAL GAS SHUT-OFF VALVES

- A. Shutoff valves (1/4" to 2") shall be FS-WW-V-35C, Type II, Class A, Style 3, 2-piece bronze ball valve with chrome plated brass ball, reduced port, durafill seats, tee handle, threaded ends, UL approved, and shall be Watts #B-6000, Resun Model #R-1430, Nordstrom Model #142, or approved substitutes.
- B. Shut-off valves sizes 2½-inches and larger shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with flanged ends, wrench operation, rated for 200 WOG service pressure and -20 to 200 degrees F., and shall be Resun Model #R-1431, Nordstrom Model #143 or approved substitutes. Proper model numbers shall be used for the actual line sizes.
- C. All natural gas valves shall be designed, manufactured and approved for natural gas service. Valves installed outside shall be rated for outdoor use with factory epoxy weather coating.

3.0 EXECUTION

3.1 PIPING SYSTEMS AND FITTING INSTALLATION

- A. All metallic natural gas piping shall have all rust removed, shall be primed with two coats of rust-inhibiting paint, and shall be painted with a minimum of two coats of rust-inhibiting yellow epoxy paint.

3.2 JOINTS AND CONNECTION INSTALLATION

- A. Joints and connections shall be permanent and shall be gas and water-tight. Jointing shall be types specified for service indicated.
- B. Joints and connections shall meet requirements of manufacturer's recommended practice.

3.3 TESTING OF PIPING SYSTEM

- A. Testing, balancing and adjusting shall not relieve guarantee requirements.
- B. Provide labor, materials, and instruments necessary for the completion of tests under the observation of the local authorities, the Department of Environmental Health and Safety, and the designated inspectors.
- C. Provide services of qualified personnel, equipment and apparatus required to perform tests.
- D. Before date of acceptance, furnish Owner with certificates of testing and inspection indicating approval of local authorities having jurisdiction and conformance with requirements of Contract Documents.
- E. Natural Gas Piping
 1. Test pressure shall be a minimum of 5 psig for 24 hours witnessed and signed off by the Owner and/or Owner's rep.

2. If inspection or tests show defects, such defective work or material shall be replaced and inspection tests shall be repeated. All repairs to piping shall be made with new materials.

3.4 COMMISSIONING OF SYSTEMS

- A. The Owner shall check the completed installation either sequentially as different parts are completed, or when the entire installation is complete, at the sole option of the Owner.
- B. Prior to the Owner's checking of part of this installation or the entire installation, submit a letter signed by an officer of this Contracting company or the Construction Manager stating:
 1. The individual is an officer of the company.
 2. The individual has personally inspected the installations.
 3. Inspection dates.
 4. The installation is complete and tested and ready to be inspected by the Owner and the Plumbing Inspector, and that required test reports have been submitted.
- C. Arrange for an officer of the contracting company, the Construction Manager, and the Plumbing Inspector to witness the listed tests, as well as to other test witnesses that may be required. At the conclusion of each such tests, submit a letter signed by the officer stating:
 1. The individual is an officer of the company.
 2. The individual has personally witnessed the tests (provide name).
 3. Test dates.
 4. Test results as compared to specified performance.
 5. List the name, title and company affiliation of those witnessing the test.
- D. All piping and system's testing shall require letters.

+ + END OF SECTION 230400 + +

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**EQUIPMENT HANDLING AND SETTING
SECTION 15056****1.0 GENERAL****1.1 SUMMARY**

A. Work Includes: furnish all supervision, labor, material, tools, and equipment to receive, unload, uncrate, inspect, move, disassemble, (if necessary), assemble, set in place, anchor and grout all equipment, including all auxiliary items and components, as shown on the drawings and described in the Scope of Work, to include the following:

1. Furnish all anchors, fasteners, grout, and other appurtenances necessary for the anchoring of equipment.
2. Provide safe access for cranes and other material handling equipment necessary for the work.
3. Furnish and place concrete and all materials necessary for inertia bases.
4. Setting and removal of all existing and new HVAC equipment as designated on the contract documents.
5. Review of all steel dunnage shop drawings to confirm HVAC equipment sizes match the steel shop drawings.

1.2 SUBMITTALS

- A. Subcontractor shall submit within 15 working days of award of contract the following as listed herein and on the Submittal Control List.
1. Catalog cuts of anchors, fasteners, grout and other appurtenances used in the Work.
 2. Certification that anchor bolts, fasteners, grout and other appurtenances used in the Work meet the design specifications as stated herein.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Equipment delivered to the jobsite and received by the subcontractor shall be:
1. inventoried and checked against the bill of lading; discrepancies shall be immediately reported to the Construction Manager (CM).
 2. unloaded promptly so as to avoid delaying the carrier; any demurrage charges shall be paid by the subcontractor.
 3. handled safely in accordance with requirements and guidelines of OSHA and Owner Safety Policies so as to protect personnel and Owner's property.

- B. Subcontractor shall protect all equipment and components from the weather at all times.
- C. Equipment and components that are received prior to the scheduled setting shall be stored and protected in accordance with manufacturer's recommendations and as directed by the CM. Storage locations shall be as directed by the CM.
- D. Stored equipment shall be protected from the elements and physical damage. Guards, barricades, lights, and other safeguards necessary for protection of persons and property shall be furnished and maintained by the subcontractor.
- E. Installed equipment shall be protected from damage until final acceptance by the CM.
- F. Instruction manuals and repair kits shall be promptly turned over to the CM.

1.4 SCHEDULING

- A. The installation sequence and work schedule will be established by the CM.
- B. The subcontractor shall coordinate equipment handling and setting with the CM. Any anticipated delays in completion schedule due to delayed shipments, damaged materials or other causes shall be reported to the CM immediately.
- C. Mobilization and demobilization of cranes and other heavy equipment transport shall be coordinated with the CM at least 10 working days in advance.

2.0 PRODUCTS

2.1 MANUFACTURERS

- A. Cast-in Specialty Anchor Bolts (1/2" diameter minimum):

Type	Manufacturer
Jakebolts & Vector Anchor Bolts	Unisorb Machinery Installation Systems
Standard & Heavy Duty Anchor Bolts	Deco Manufacturing Company
Foundation Bolts	Dekalb Fasteners Inc.

- B. Clamps and Specialty Connections:

Type	Manufacturer
Ubolts	Dekalb Fasteners Inc.
Lindaptor Systems	Lindaptor North America, Inc.

- C. Cold or hot formed specialized channels or assemblies:

Type	Manufacturer
Unistrut	Unistrut Corporation
B-Line	B-Line Systems Inc.
Hilti Strut	Hilti, Inc.

D. Inserts, Bolts and Anchors (Retrofit Style):
1. Floor Mounted - Concrete

Type	Manufacturer
All types	Hilti, Inc.
All types	Powers/Rawl
All types	Ramset/Red Head

2. Column Mounted

Type	Manufacturer
Adhesive & mechanical anchors	Hilti, Inc.
Adhesive & mechanical anchors	Powers Fastening, Inc. (Powers/Rawl)
Adhesive & mechanical anchors	ITW Ramset/RedHead
Ubolts or other specialty anchors	Dekalb Fasteners, Inc.

3. Wall, Horizontally Mounted (Pilaster or Concrete)

Type	Manufacturer
Adhesive anchors	Hilti, Inc.
Adhesive anchors	Powers Fastening, Inc. (Powers/Rawl)
Adhesive anchors	ITW Ramset/RedHead

4. Hung or ceiling (structural)

Type	Manufacturer
Adhesive anchors, undercut or sleeve anchors	Hilti, Inc.
Adhesive anchors, undercut or sleeve anchors	Powers Fastening, Inc. (Powers/Rawl)
Adhesive anchors, undercut or sleeve anchors	ITW Ramset/RedHead

5. Roof Mounted

Type	Manufacturer
All types	Hilti, Inc.
All types	Powers Fastening, Inc. (Powers/Rawl)
All types	ITW Ramset/RedHead

E. Equipment Grout:

1. V-1 Machinery Mounting and Anchoring Grout by Unisorb providing 5000 psi at 1 day and 11,000 psi @ 28 days.
2. Masterflow 928 by Master Builders Technologies providing 3500 psi @ 1 day and 7500 psi @ 28 days.
3. Sure Grip High Performance Grout by Dayton Superior providing 3500 psi @ 1 day and 7500 psi @ 28 days.
4. C9 200 PC Cementaceous Grout by Hilti providing 2500 psi @ 1 day and 8500 psi @ 28 days.

2.2 MATERIALS

- A. Fasteners, anchors, washers, and nuts shall be minimum 5 micron galvanized unless used in wet environments where they shall be:
 - 1. hot dip galvanized, minimum 0.9 oz. per square foot in accordance with ASTM Standards, or
 - 2. stainless steel Type 304.
- B. Steel design and fabrication shall be in accordance with:
 - 1. AISC American Institute of Steel Construction
 - 2. AWS American Welding Society
- C. Cold formed stainless steel design and fabrication shall be in accordance with ASCE 8 (American Society of Civil Engineering), "Specification for the Design of Cold-Formed Stainless Steel Structural Members".
- D. Plates, bars and shapes shall be in accordance with ASTM A6 and ASTM A36, $F_y = 36$ ksi, $F_u = 50$ ksi.
- E. Plain rods, threaded rods, anchor bolts, through bolts, and upset rods shall be in accordance with ASTM A307, $F_y = 36$ ksi, $F_u = 60$ ksi, or ANSI Type 304 stainless, $F_y = 30$ ksi min.
- F. Stainless steel bolts shall be in accordance with ASCE 8 and one of the following ASTM standards: A193, A276 or A593.
- G. Sleeve nuts, clevises, turnbuckles, pins, cotter pins shall conform to the 5:1 safety factors and requirements of AISC and ANSI.
- H. Square and rectangular HSS (Hollow Structural Shape) closed sections of steel shall be in accordance with ASCE 8 or ASTM A-500, Grade B, $F_y = 46$. Round HSS sections and pipes shall be in accordance with ASTM A-53, Grade B, $F_y = 35$ ksi.

2.3 FINISHES

Exposed steel members shall be prepared per SSPC-SP3 (Structural Steel Painting Council) and prime painted with an approved material applied with no less than 2 mils d.f.t.

3.0 EXECUTION

3.1 EXAMINATION

The subcontractor shall visit the jobsite, verify site conditions, and determine all handling requirements for each piece of equipment to be set in place.

3.2 PROTECTION

- A. Floors and roofs shall be protected from all damage while moving and installing equipment.
- B. Adequate planking or other means of protection shall be provided to properly distribute loads applied while moving and installing equipment.
- C. Cutting, drilling, welding and other modifications to Owner's property to support or rig equipment shall not be permitted without the approval of the CM. No mechanisms or apparatus required for handling equipment shall be attached to building structural steel without the approval of the CM.
- D. Subcontractor shall be responsible for repairing any damages and restoring Owner's property to original condition upon completion of the Work.

3.3 HANDLING AND SETTING

- A. Large pieces of equipment shall be moved into their proper rooms prior to removing skids. Smaller pieces of equipment may be uncrated at any convenient location prior to moving into installation area. Instruments and sensitive equipment shall remain packed in cases until ready for installation.
- B. Install in accordance with Manufacturer installation recommendations. Manufacturer's installation specialists (where consulted) shall have full authority in all matters concerning method of installation, preparation of materials, workmanship standards, etc. Activities under these specifications shall be coordinated so as not to unduly retain manufacturers' specialists at the jobsite
- C. All multi-component equipment shall be handled in such a manner as to avoid any damage, misalignment, separation, etc. of the components. Lifting devices such as eye bolts and lugs shall be supplied when not included with equipment. All costs of repair and/or replacement will be borne by the subcontractor.
- D. All equipment shall be set on centerlines and elevations as per plan and elevation drawings and be aligned per manufacturer's instructions.
- E. The subcontractor shall furnish all shims, liners, wedges and plates that are required to properly align or level equipment.
- F. The subcontractor shall check all anchor bolts before attempting to set equipment. Sleeves, where required, shall be cleaned out and bolts properly positioned. The subcontractor shall drill, weld, and tap as necessary to properly set the equipment. The subcontractor shall assemble and coordinate the installation of all equipment complete with motor, drives, couplings, guards, isolators, inertia bases and other appurtenances.
- G. After equipment is set and anchored, subcontractor shall remove lugs, brackets, blocking devices and bracing which were installed solely for shipping and handling, as directed by the CM.
- H. Subcontractor shall furnish and place concrete in inertia bases when furnished with equipment.

- I. Before permanently setting and grouting equipment with flexible piping connections, the flexible connections shall be in a neutral position proven during actual operating temperatures.

3.4 GROUTING

- A. Grouting shall be in accordance with grout manufacturer's recommendations.
- B. All dirt, oil, grease and other foreign material shall be removed from concrete and steel surfaces. Defective concrete shall be removed, leaving a level roughened surface.
- C. Install equipment to provide a minimum 1" clearance between the top of the concrete and the underside of the equipment base. After equipment is in place and properly leveled and aligned, foundation bolts shall be tightened evenly but not too firmly.
- D. Completely fill the clearance space with grout; grout the leveling pieces, shims or wedges in place. The grouting methods shall ensure that no air pockets or hollow areas exist in the equipment base.
- E. After the grout has hardened in accordance with manufacturer's recommendations, foundation bolts shall be tightened.

3.5 CLEANING

At the completion of each day's work, the subcontractor shall dispose of all crating materials and construction debris and leave the jobsite broom-clean.

++END OF SPECIFICATION 230560++

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1.0 GENERAL

1.1 SUMMARY

- A. Work Includes: furnish and install all materials, accessories and components necessary for the complete installation of insulation for all interior and exterior ductwork as shown on the Drawings.

1.2 DEFINITIONS

- A. The word "interior" shall be taken to mean any ductwork or insulation which is located inside a structure, not exposed to weather.
- B. The word "exterior" shall be taken to mean any ductwork or insulation which is located outside of a structure, or is otherwise subjected to the weather.
- C. The word "concealed" shall be taken to mean any ductwork or insulation above ceilings, mechanical chases and other places where the insulation is not exposed to physical abuse.
- D. Ductwork in accessible service shafts is to be considered as "exposed." The word "exposed" shall be taken to mean any ductwork in mechanical equipment spaces or other places where it is subject to physical abuse.

1.3 SUBMITTALS

- A. The subcontractor shall submit a schedule outlining the specific products being used and material data sheets for all products being used. If the subcontractor proposes materials or methods other than those specified, but of equal or higher quality, samples and performance data shall be submitted to the Construction Manager (CM) for evaluation and acceptance at the time of bid submission.
- B. Shop drawings/data sheets for adhesives, coatings, mastics, sealants and solvents shall be accompanied by a Material Safety Data Sheet.
- C. Provide copies of performance test data reports.

1.4 QUALITY ASSURANCE

- A. Subcontractor shall have not less than five (5) years experience as a Mechanical Insulation Contractor with specific experience in ductwork insulation fabrication techniques, application and installation of the material types and thicknesses, protective coverings, and accessories as referenced herein, and as shown on the engineering drawings and/or bid documents. The Owner reserves the right to verify all subcontractors' qualifications, or to require that the subcontractor provide specific work experience documentation.
- B. Flame spread index values indicated for the specified materials shall be determined in accordance with ASTM E-84 "Surface Burning Characteristics of Building Materials."

- C. Insulation materials shall be delivered to the job site in the manufacturer's standard packaging or sealed containers bearing the manufacturer's stamp or label showing manufacturer's name, brand name, material type and size.
- D. Any work and/or material shall be inspected by the Owner or designated representative at any time. Any work or material found to be defective or which does not meet the requirements of this or other prescribed specifications, shall be replaced by the subcontractor at his own expense. Such inspection shall not relieve the subcontractor from full responsibility for the quality or correctness of his work.
- E. Codes and Compliance:

All materials and workmanship described herein shall be in accordance with the latest editions and addenda of the codes and standards listed below and all Federal, State and local codes and best accepted practices of the trade. Where this specification is more stringent than those above, this specification shall govern. Where direct conflicts arise, the CM shall be notified prior to installation for clarification.

ASTM	American Society for Testing and Materials
FM	Factory Mutual Engineering Division
FS	Federal Specifications
MICA	Midwest Insulation Contractors Association National Commercial and Industrial Insulation Standards.
MIL	Military Product Specifications
MSS	Manufacturers Standardization Society
NFPA	National Fire Protection Association Standards
NICA	National Insulation Contractor's Association
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association, Inc.
TIMA	Thermal Insulation Manufacturers Association
UL	Underwriters Laboratories, Inc.

1.5 WARRANTY

- A. The subcontractor shall guarantee that insulation system which becomes defective as a result of faulty materials or workmanship within one year from acceptance shall be removed and replaced complete with all adhesives, jacketing, and related materials, at no additional cost to the Owner. This work shall be done to the original specifications and to the complete satisfaction of the CM/Owner.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The subcontractor shall be fully responsible for all handling and storage of his materials and equipment.
- B. Protect materials against damage during storage and through all stages of installation work. Replace all damaged insulation materials to the satisfaction of the Owner at no additional cost to the Owner.

- C. Subcontractor shall exercise extreme caution in the storage and handling of flammable adhesives and coatings. These materials shall not be used or stored in any area where open flames, welding sparks, or smoking may occur.

2.0 PRODUCTS

2.1 DUCTWORK INSULATION MATERIALS

- A. The insulation materials shall be as specified on the individual specification sheets attached hereto. Each specification sheet represents a complete insulation system including insulation material and adhesives, mastics, fasteners, coverings and related accessories to be used.
- B. Factory applied all service jacketing (ASJ) for rigid board and factory applied foil scrim Kraft (FSK) jacketing for flexible blanket fiberglass insulation material shall be UL rated bleached Kraft paper laminated to aluminum foil vapor barrier and reinforced with fiberglass yarn. Kraft paper shall be treated with permanent flame and smoke retardant and treated to prevent corrosion of foil. Mullen Bursting strength shall be 70 psi or greater when tested in accordance with ASTM D-774. Permeability rating shall be 0.02 when tested in accordance with ASTM E-96, procedure A. All seam laps shall be a minimum of 1-1/2 inches.

2.2 INTERIOR DUCT INSULATION FIBERGLASS BLANKET

- A. Insulation shall be Certain-Teed, Kanuf, Manville or Owens Corning. Install insulation, mastics, adhesives, coatings, covers, and other work exactly as required by manufacturer's recommendations. Material shall meet requirements of Adhesive and Sealant Council Standards and SMACNA.
- B. ASTM E-84 minimum fire hazard ratings shall be 25 flame spread, 50 fuel contributed and 50 smoke developed.
- C. Fiberglass blanket type insulation for rectangular and round ductwork, manufactured from resilient, inorganic glass fibers bonded by a thermosetting resin, shall conform to ASTM C-553 Type 1, Class B-3, nominal density of 3/4 lb/cu ft, and have an out of package R value of 8.0 at 75°F mean temperature, with Foil/Scrim/Kraft vapor barrier facing.

CertainTeed Corporation	100 Standard Duct Wrap FSK
Knauf	Duct Wrap
Owens-Corning	All Service Faced Duct Wrap FSK
Johns Manville	Microlite Duct Wrap FSK

- D. Lap and Joint Adhesive:

Childers Products Co.	Chil-Stix FRM (CP-83)
Epolux Manufacturing Corp.	Cad-0-Preme 400
Foster Division, H.B. Fuller Co.	85-20 Spark-Fas
Vimasco	733

2.3 EXTERIOR DUCT INSULATION

- A. Rigid, modified polyisocyanurate cellular plastic board type insulation, have an out of package R value of 12.0, nominal density of 3.0 lbs/cu ft at 74°F, and shall have thermal

conductivity (initial K factor) of 0.14 Btu-inch/hour, sq ft, °F at 75°F mean temperature per ASTM C-518. Closed cell content shall be 97% at 74°F per ASTM D-2856, maximum water absorption of 0.6% by volume per ASTM C-272, and water vapor permeability of 2.9 perm-inch per ASTM E-96. Surface burning characteristics for one inch thick specimen shall have flame spread of 25 and smoke density of 160 per UL 723, Class 1.

Dow Chemical Company

Thermax Sheathing

B. Miscellaneous Accessories

1. Bonding/Joint Adhesive:

Childers Products Co.	Chil-Rene CP-96
Epolux Manufacturing Corp.	463
Foster Division, H.B. Fuller Co.	81-33 Fire Resistive
Miracle	1150/122

2. Joint Sealant:

Childers Products Co.	Chil-Byl CP-76
Foster Division, H.B. Fuller Co.	Elastolar 95-44/95-50
Pittsburgh Corning	444

3. Reinforcing Membrane:

Childers Products Co.	Chil-Glas #10
Foster Division, H.B. Fuller Co.	Mast-A-Fab
Pittsburgh Corning	PC Fabric 79

4. Mastics & Coatings (Below Ambient)

Childers Products Co.	Encacel X or V
Epolux Manufacturing Corp.	600/620
Foster Division, H.B. Fuller co.	Monolar 60-38/60-56

5. Mastics & Coatings (Above Ambient)

Childers Products Co.	CP-10, CP-11
Epolux Manufacturing Corp.	500 series
Foster Division, H.B. Fuller Co.	Sealfas G-P-M 35-00/45-00
Pittsburgh Corning	404

2.4 METAL JACKETING FOR EXTERIOR DUCTWORK

A. General:

Manufactured from aluminum or stainless steel and shall be a complete, factory fabricated system consisting of pre-cut and formed sections of smooth finish with a continuous modified Pittsburgh Z-Lock on the longitudinal seam. Each section of jacketing shall have a self-gauging two inch built in overlap and strapping band for the overlap location. Provide factory-applied, integrally bonded moisture barrier consisting of six mil material similar to Venture Clad 1577CW.

B. Aluminum Duct Jacket:

Manufactured from Type 1100, 3003, 3105, and 5005 aluminum alloys, in the temper range of H14 through H19, conforming to ASTM B-209. Jacket thickness of 0.032" shall be used. Duct fitting jackets shall be fabricated of same material and gauge thickness as straight run duct jacket with same moisture barrier interior coating bonded to entire surface in contact with insulation.

Childers Products Co.	Aluminum Strap-On Jacketing
Epolux Manufacturing Corp.	
Pabco Division, Fibreboard Corp.	

C. Strapping Band:

Factory-fabricated from 0.020" gauge soft annealed Type 304 stainless steel with de-burred edge and 0.032" wing seals attached.

Childers Products Co.	Fabstraps 3/4" wide
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D. Caulk/Sealant for Aluminum Duct Jacket:

Permanently flexible vapor sealant for low, dual and high temperature insulation application.

Childers Products Co.	Chil-Joint CP-70 or Chil-Byl CP-76
Foster Division, H.B. Fuller Co.	30/45 or 95-44/95-49
Mastics and Adhesives, Inc.	S-31 or S-16
Pittsburgh Corning	Pittseal 444N

3.0 EXECUTION

3.1 GENERAL

- A. The subcontractor shall be required to take all necessary safety precautions, furnish all supervision, materials, labor, tools, scaffolding, ladders, and all necessary equipment to execute, construct, and finish in an expeditious, substantial and workmanlike manner all ductwork insulation required.
- B. Insulation shall be installed, and accessories provided, in strict accordance with manufacturer's instructions and recommendations, in compliance with specified requirements, codes and regulations, and in adherence with good industrial practice

applicable for each type of work. Where a conflict occurs between this specification and the manufacturer's instructions, contact the CM for a clarification.

- C. Work shall be executed by skilled mechanics under the direction of a qualified supervisor thoroughly knowledgeable and experienced in the basic principles required for application of insulation, protective coatings and accessories.
- D. Insulation shall be applied to clean, dry, inspected, and tested ductwork.
- E. Make joints tight, with insulation lengths tightly butted against each other. Where lengths are cut, make cuts smooth and square, without breaking end surfaces. Where insulation terminates, neatly taper ends and seal or finish as specified. Direct longitudinal seams of exposed insulation away from normal view where possible.
- F. Cutouts in the insulation for coils, flexible connections, access doors, pitot tube openings, nameplates, control devices and equipment tags shall have all edges cut clean and square, and the jacket and/or vapor barrier sealed to the surface.

3.2 INSULATION OF DUCTWORK

A. General:

1. Seal all joints, cracks, and breaks (including holes for the fasteners) in the vapor barrier with a vapor barrier mastic and vapor barrier jacket material similar to the vapor barrier jacket on the rest of the insulation. Also seal breaks in the vapor barrier caused by the attachment of tubing or control devices. Apply the mastic at the rate recommended by the manufacturer.
2. Pressure sensitive tape, self-sealing laps and other types of factory supplied adhesives are acceptable only for insulation with FSK jacketing. When used, additional mastic/adhesive shall be applied over the tape or lap.
3. On ducts with surface temperatures below 35°F, a 6" wide piece of 2 pound density polyisocyanurate foam board shall be inserted between the duct and duct channel hangers. The foam board shall extend the full width of the duct and its thickness shall match the thickness of the adjacent insulation. The foam board shall be covered with vapor barrier jacket to match the duct insulation, and shall be fully sealed with mastic to form a vapor proof seal.
4. For exterior ductwork apply polyisocyanurate foam board insulation to the duct with adhesive and welding type pins 12" on center in both directions. Fasteners shall be located 2" from the edge of the duct. No surface shall have fewer than two rows of fasteners. Apply cap strips of insulation over all stiffener angles to provide an insulation thickness of 1/2" over the protrusion. The cap strips shall be minimum 3" wide.

B. Flexible Blanket Insulation:

1. Apply flexible fiberglass blanket insulation by use of the staple stitch method or the butt joint method. With either method, apply mechanical fasteners on the bottoms and sides of horizontal ducts 18" or wider. For vertical ducts, 18" or wider,

mechanical fasteners shall be applied on 12" maximum centers on all sides of the duct. For ductwork whose perimeter is 60" or less, mechanical fasteners may be stick pins or weld pins with speed washers. For ductwork whose perimeter is greater than 60", mechanical fasteners shall be weld pins and speed washers.

2. Where space or job site conditions constrain the installation of weld pins and speed washers or cupped head weld pins, self adhesive stick pins may be used. Such instances must be specifically approved by the CM before the subcontractor may proceed with the installation.
3. Place the pins 3" from the butt joints and 12" on center. Clip washers are to be installed on the pins and depressed below the surface of the insulation. Cut off the pin flush with the washer. With the butt joint method, longitudinal joints are to be lap joints having a minimum of a two inch lap sealed with vapor barrier mastic. Using the staple stitch method, the longitudinal joint shall be lapped and folded to form a seam. The seam will then be stapled using clinch type staples no greater than 2" on center. With both methods, butt joints shall be covered with vapor barrier material adhered by vapor barrier mastic. Care shall be taken in installation of flexible duct wrap to minimize the amount of compression of the insulation. No more than 20% compression will be allowed.

3.3 JACKETING INSTALLATION

- A. Apply protective aluminum jacketing to all exterior and fire covered ductwork.
- B. Metal jacketing shall be dimpled with factory applied moisture barrier. Install the jacketing with 2" horizontal and vertical laps, with horizontal laps turned down to shed water. Apply with self sealing pop rivets, a stainless steel mandrel and 3/4" back-up washer. Pop rivets are to be installed 1" from the end of the jacket material, 2" on center. Seal all joints after riveting. As an alternative, use a metal jacketing system with manufacturer's locked, weatherproof seam. Follow directions supplied with material.

3.4 DUCT INSULATION SCHEDULE

- A. The ductwork systems to be insulated and the product specification requirements are as shown in the following table:

System	Class	Material	R-Value (Out of Package)
RTU-1 Exterior Supply Air	Exposed	Polyisocyanurate with Venture Clad 1577CW Vapor barrier and .032" thick aluminum jacketing for ice fall protection	R-12.0 min. - 2" Thick required to cover duct supports
ACU-1 Supply and Return Ductwork	Concealed	Fiberglass Blanket	R-8.0 Out of Package

- B. The ductwork systems that are within the conditioned space and not located within the ceiling space shall not be insulated.
- C. All ductwork with interior lining shall also be insulated per the above schedule.

++ END OF SECTION 232600 ++

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1.0 GENERAL

- A. This specification covers supports and hangers for all mechanical piping systems.
- B. This section shall include all tools, equipment, and materials needed to install the hangers and supports listed in the contract documents and/or this specification.
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-Hanger shield inserts.
 - 5. Fastener Systems.
 - 6. Pipe Stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
 - 9. Inserts and Anchors
- C. The Mechanical Contractor (hereafter the Contractor) shall furnish and Install hangers and supports (as required for piping systems) and any miscellaneous steel required for supporting the piping and for attachment of hangers and supports.
- D. The work shall be designed and installed with regard to appearance and convenience as well as in compliance with all applicable laws, regulations, and industry standards. Details of all attachments are subject to the approval of the Owner or Owner's Representative.
- E. The Contractor shall obtain approval by the Owner or Owner's representative before proceeding with the drilling or punching of any holes in the building structure. Written approval must be obtained.
- F. All piping shall be furnished with seismic restraints in accordance with Seismic Hazard Level of the Seismic Restraint Manual: Guidelines for Mechanical Systems and in accordance with any applicable local codes. Refer to section 2.0 this specification.
- G. Attachment of supports or hangers to columns or beams which require fire proofing shall be coordinated with the fire proofing contractor. Fire proofing removed by the Contractor shall be replaced at their cost.

1.1 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Where not fully called for in the contract documents, design of hangers and supports shall confirm to accepted engineering practice using factor of safety of 2-1/2.

- D. All pipe hangers and supports shall confirm to ANSI B31.1- Power Piping, and Documents MSS SP-58 and SP-69 of the manufacturers standardization Society of the Valve & Fittings Industry.

1.2 SUBMITTALS

- A. Submit each item in this Specification according to the conditions of the Contract and Division 1 Specification Sections.
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems.
 4. Pipe positioning system.
 5. Inserts & Anchors
- B. Shop drawings are to include fabrication and installation details and include calculations for the following.
1. Trapeze pipe hangers. Include product data for components.
 2. Metal framing systems. Include product data for components.
 3. Pipe stands. Include product data for components.
 4. Equipment support.
 5. Drawings covering all specially designed hanger assemblies and fabrications.
- C. Welding Certificates

1.3 QUALITY ASSURANCE

- A. Welding: Qualified procedures and personnel according to AWS D1.1 “Structural Welding Code-Steel.”
- B. Welding Qualified procedures and personnel according to the following:
1. AWS D1.1, “Structural Welding Code—Steel.”
 2. AWS D1.2, “Structural Welding Code—Aluminum.”
 3. AWS D1.3, “Structural Welding Code—Sheet Steel.”
 4. AWS D1.4, “Structural Welding Code—Reinforced Steel.”
 5. ASME Boiler and Pressure Vessel Code: Section IX.
- C. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

1.4 DESIGN AND SELECTION INSTRUCTIONS

- A. Piping shall be supported, anchored, or guided to prevent undue line deflection or excessive vibration, and to protect piping connected to equipment from excessive loading and expansion stresses.
- B. Supports for all lines are to be selected by the contractor (unless otherwise indicated on the drawings or specified herein).
- C. Wherever possible, pipes shall be supported in groups at a common support elevation using resting type structural supports or rack framing.
- D. Non insulated lines shall rest on support member.
- E. Steel shoes shall be used for anchors, guides, and resting supports on lines insulated for heat conservation unless otherwise specified or indicated on the drawings.
- F. All lines routed in pipe racks (horizontal and vertical) must be guided. Spacing of guides not to exceed 25 ft for lines $\leq 2\ 1/2''$ and 40 ft for lines $\geq 3''$ unless otherwise noted on drawings.
- G. Individual lines may be suspended via hanger rod assemblies (when not supported in common groups) see section 2.0 for additional details.
- H. Concentrated point loads, such as control valves, duplex strainers, line mounted instruments, etc., shall be individually supported.
- I. Loads at pump suction and discharges shall be supported in a manner that will comply with manufacturer's recommendations per vendor drawings.
 - 1. When manufacturer's allowable loads are not available, utilize API Std. 610 allowable loads for comparison with reaction load due to thermal expansion. Considerations should be made for lower than API allowable loads for ANSI pumps. Mechanical Loads (dead wt.) shall be handled by adequate support location.
- J. Adjustable supports are required on piping connections to pumps, turbines, and compressors.
 - 1. Rod hangers or adjustable type base supports shall be used to ease equipment strain and facilitate erection. When space does not permit adjustable type base support, then a rigid stanchion may be used provided leveling nuts are specified under base plates.
- K. Supports shall be located as near as practical (2ft. maximum) to all changes in direction (horizontal and vertical).
- L. The design and selection of supports shall ensure that bare lines do not rest on concrete so as to avoid accelerated corrosion of piping at the point of contact.
- M. Where rigid supports cannot be used due to vertical expansion of piping, it is necessary to

provide spring assemblies which will allow the piping to move and still maintain support. Design of these types of supports shall be by this Contractor.

- N. Where there is horizontal movement at a hanger location, the vertical angle of the rod shall be limited to 4 degrees.
- O. For movement greater the 2", set shoes off center half the amount of expansion at point of support in the opposite direction of movement.
- P. Notify Owner if pipe support loads exceed 2000 lb. at column lines. Loads between column lines will transfer to the column line and are to be considered as part of the column line load. Attachments to building structural elements shall be mechanical. Welding to building steel is per specific approval by owner.

1.5 SUPPLY, FABRICATION, AND INSTALLATION INSTRUCTIONS

- A. Pipe supports may be shop or field fabricated. The contractor shall be responsible for purchasing all pipe support materials required to complete construction.
- B. Pipe supports, such as trunnions and base ells, for shop fabricated with the piping.
- C. Hanger rods shall be set vertically plumb.
- D. Structural steel shoes for anchors, guides, and resting supports shall be set in place under pipe and offset adjusted per section 1.4 of this specification before welding pipe.
- E. Rod hangers and spring assemblies are to be shipped completely assembled.
- F. During hydrostatic testing of lines supported by springs, counterweights, etc., temporary rigid supports or blocking must be installed to prevent excessive strain on piping and equipment and overloading of spring devices.
- G. All Shoes, trunnions, and other metal to metal type sliding supports shall be cleaned by wire brushing to ensure unrestricted movement.
- H. Shipping rods on expansion joints are to be removed after installation of joints.
 - 1. Pipe must be properly anchored and guided before testing lines with expansion joints.
 - 2. Where tie rods are used, care should be taken to see that they are locked in proper position before testing and re-adjusting.
- I. The Contractor may suggest alternative support methods to those shown on piping drawings if a more cost effective or practical method would result, however, alternative methods may not be implemented until expressly approved by the engineer.
- J. Compression spring hangers and supports are shipped to the jobsite assembled with the spring compressed.

1. The Contractor shall adjust the spring to the cold load as indicated on the pipe support sketch. Cold setting should take place after hydro test and mechanical completion but prior to final alignment of associated equipment.

1.6 SEISMIC REQUIREMENTS

A. General

1. Seismic bracing shall be provided as required by the applicable Building Code for this project.
2. Seismic bracing support details shall be chosen from the typical bracing details provided on the drawings. Correct sizing, spacing, and materials for restraints shall be chosen from the B-line Seismic Restraint catalogue produced by Cooper B-Line. A copy of the seismic Restraint Manual shall be kept on the job site for the duration of the project.

B. Seismic restraints may be omitted from piping supports if all of the following conditions are satisfied.

1. The piping is made of ductile material with ductile connections.
2. Lateral motion of the piping does not cause impact of fragile appurtenances (e.g. sprinkler heads), equipment, piping, building structure, or structural member.
3. Lateral motion of piping does not cause loss of the system vertical support.
4. Rod hung supports of less than 12" in length have top connections that cannot develop moments.
5. Support members cantilevered up from the floor are checked for stability.

C. Seismic restraints may be omitted for the following conditions where flexible connectors are provided between components and the associated piping:

1. Fuel piping less than one inch inside diameter.
2. All other piping less than 2 1/2 inches inside diameter except medical gas piping (including vacuum)
3. All piping suspended 12" or less from top of pipe to bottom of structural support.

2.0 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers and Supports
 - a. Hanger shall be Carpenter and Paterson, F&S, or Grinnell Co. Figure numbers of Carpenter and Paterson are specified to establish standards of quality for performance and materials.
 - b. Hangers and Pipe shields shall be sized for the pipe and insulation thickness. No shaving will be allowed. See pipe insulation Specs for insulation thickness requirements.

2.2 INSERTS, ANCHORS AND BEAM SUPPORTS

- A. Where support rod sizes exceed 7/8" diameter or where the load exceeds the recommended load for the insert or anchor, use two inserts or anchors with trapeze-type connecting member below the concrete.
- B. Where installation can be made before the concrete is poured, use Figure 650 or 650N.
- C. Where installation is made after the concrete is in place, use Phillips "Red Head" expansion anchors, raw studs, raw self-drilling anchors, Hilti Kwik-Bolts.
- D. Plastic, lead or fiber screw anchors, lag screws, and expansion shields are not acceptable.
- E. Where continuous inserts are required, they shall be Unistrut or approved equal, formed from not less than 12 gauge galvanized steel with anchors spaced on not less than 6" center, and with end caps, splice plates, bolts, and nuts as required by conditions. In rooms with defined environmental requirements, more sanitary provisions must be made as called for on the drawings or elsewhere in these specifications.
- F. For attachment to beams, use Figures 82, 217, 268, 297, 314, or 702.

2.3 SINGLE PIPE HANGERS

- A. Single pipe hangers shall be supported by hangers suspended by galvanized steel rods from structural steel members, concrete ceilings and beams, bottom of trapeze hangers and wall mounted steel angle brackets.
- B. Hanger rods shall be hot rolled steel, machine threads and galvanized after fabrication. The strength of the rod shall be based on its root diameter.

- C. Except as otherwise specified herein, pipe hangers shall be adjustable clevis type similar to Grinnell Figure Numbers 65,260, and 590 as required. Hangers shall be carbon steel with a galvanized finish.
- D. Where pipes are near walls, beams, columns, etc. and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Paterson Figure number 69-68, 84 or 139 shall be used for hanging pipe. Brackets shall be galvanized. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.4 MULTIPLE PIPE HANGERS

- A. Suspended multiple pipe, running parallel in the same horizontal plane which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns, or structural steel support members as required to meet the intent of this specification. Channel shall be similar to F&S Figure 710, rods, concrete inserts; "C" Clamps, beam clamps, welded beam attachments, and expansion shields shall be as specified in section 2.3 Single Pipe Hangers.
- B. Except as otherwise specified herein pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chair similar to F&S Figures 158, 419, 160A, or 160B as required. Materials of construction shall be galvanized steel. Chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contracting except when pipe must be anchored to control direction of movement or act as a thrust anchor.

2.5 SINGLE AND MULTIPLE PIPE SUPPORTS

- A. Single pipe located in a horizontal plane close to the floor shall be supported by one of the methods specified herein or as shown on the drawings.
- B. Pipe 3" diameter and larger shall be supported by adjustable stanchions similar to F&S Figure 427 and constructed of galvanized steel. Stanchions shall provide at least 4" of adjustment and flange mounted to floor.
- C. Pipe less than 3" in diameter shall be held in position by supports fabricated from steel C channel, welded post base similar to Unistrut Figure p2072A, and pipe clamps similar to Unistrut Figures P1109 thru P1126. Where required to assure adequate support, fabricate supports using two vertical members of sufficient load capacity to support pipe. Wherever member to provide horizontal rigidity, more than one pipe may be supported from a common fabricated support. All supports unless specified elsewhere shall be galvanized.
- D. Where required, pipe shall be supported using concrete anchor posts. Pipe shall be securely fastened to concrete anchor posts using suitable metal straps as required and approved by the engineer.

2.6 WALL SUPPORTED PIPES.

- A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall, whenever deemed necessary, be supported using welded steel wall brackets similar to Carpenter and Paterson figure numbers 69-78, 84, or 134; or “C” Channel with steel brackets similar to Unistrut pipe clamps. All members shall be securely fastened to wall column, etc. using double expansion shields or other method as approved by the engineer.
- B. Pipe shall be attached to supports using methods specified herein.
- C. All supports shall be galvanized. Unless noted otherwise.

2.7 BASE ANCHOR SUPPORT

- A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base anchor support shall be installed at the bend to carry the load. The bend anchor shall be fastened to the floor with double expansion shields or other method as approved by the engineer.
- B. Where shown on the drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to concrete supports with suitable metal bands as required and approved by the engineer.

2.8 VERTICAL PIPE SUPPORTS

- A. Where vertical pipes are not supported by a system as specified in part 2.8, they shall be supported in one of the following methods.
 - 1. For pipes 1/4” to 2” in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe being supported. The hanger ring shall be galvanized steel or PVC clad depending on the supported pipe. The hanger ring shall be equal to Carpenter & Paterson Figure number 81 or 81CT. The anchor flange shall be galvanized malleable iron similar to Carpenter & Paterson Figure number 85.
 - 2. For pipes equal to or greater than 1/2” in diameter extended pipe clamps may be used. The hanger shall be attached to concrete structures using double expansion shields or to steel support numbers using welding lugs similar to Carpenter & Paterson figure number 220.
 - 3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be galvanized steel similar to Carpenter & Paterson figure number 126. Copper clad or PVC coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps.
 - 4. Unless otherwise specified, shown, or specifically approved by the engineer, vertical runs exceeding 11 ft, shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.

2.9 SPECIAL SUPPORTS

- A. Pipe supports shall be provided for closely spaced vertical piping systems as shown on the drawings or as otherwise required to provide a rigid installation. The support system shall consist of a framework suitably anchored to floors, ceilings, and walls and as manufactured by the Unistrut Corporation, Globe-strut as manufactured by the Metal Products Division of U.S. Gypsum or equal.
- B. Vertical and horizontal supporting members shall be U shaped channels similar to Unistrut Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps equal to Unistrut Series P1100M and Series P2558. All components shall be of mild steel.
- C. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all members.
- D. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above, shall be submitted and shall show all details of the installation including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.
- E. Any required pipe supports for which the supports specified in this section are not applicable shall be fabricated or constructed from standard structural steel shapes in accordance with AISC Specifications, have anchor hardware similar to items previously specified herein, shall meet the minimum requirements listed below, and are subject to the approval of the engineer.
 - 1. Pipe support systems shall meet all requirements of this section and all related sections of the specification.
 - 2. Complete design details of the entire pipe support systems shall be provided for review by the engineer.
 - 3. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

3.0 EXECUTION

3.1 DELIVERY AND STORAGE

- A. All supports and hangers shall be crafted, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished iron or steel surfaces not galvanized or painted shall be properly protected to prevent rust corrosion.

3.2 INSTALLATION

- A. The Contractor shall furnish and install all structural supports, anchors, and hangers required for the suspension and placement of the piping required for this installation. Pipe hangers and supports shall be installed to allow for expansion and contraction and placed close fittings, valves, and heavy equipment. They shall be installed so that piping will be free from vibration, sagging, or movement other than that caused by heat expansion or contraction. Piping shall be pitched as specified in individual service specifications.
- B. Piping shall be supported directly from the structure and not from the supporting systems or equipment of other trades.
- C. Pipe may be supported by trapeze hangers and/or in tiers leaving sufficient room for installation of fittings, insulation, etc., and for future work or maintenance.
- D. There shall be no cutting, drilling, or welding on the building steel except as shown on the contract drawings or as instructed by the Owner's rep.
- E. Hanger rods shall be connected to beam clamps, concrete inserts, or expansion anchors. C clamps shall not be allowed. Offset suspension by hangers is not permitted.
- F. Hanger rods shall be installed with double nut arrangement both at the lower end where the hanger is attached, and at the top where it fastens to the clamp or insert. Where rod sizes are not listed, the rod size shall conform to the following table.

<u>Pipe Size, in.</u>	<u>Rod size, in.</u>
2 and smaller	3/8
2-1/2 to 3-1/2	1/2
4 and 5	5/8
6	3/4
8 to 12	7/8
14 and 16	1

- G. Inserts shall be provided as specified elsewhere in this specification. When through bolts are used, plates or large washers shall be provided under the heads.
- H. Piping related equipment (e.g., filters, meters) shall be located as shown on contract drawings or as instructed by the Owner's representative. All such equipment which must be secured to concrete walls, ceiling slabs, columns, other building masonry, and floors shall be attached by means of approved insert and/or fasteners as listed in this specification.

- I. Maximum spans between hangers for straight horizontal runs of steel and copper pipe shall be in compliance with the following table:

Nominal Pipe Size (inches)	Maximum Span (feet)	Nominal Pipe Size (inches)	Maximum Span (feet)
1/2	5	4	14
1	5	6	17
1-1/2	8	8	19
2	10	10	22
2-1/2	11	12	23
3	12	14	25

Additional hangers shall be provided where concentrated weights such as valves or heavy fittings occur and where changes in direction of the piping system occur between hangers or as noted on the drawings.

- J. Reduce spacing to a maximum of 10'-0" apart regardless of pipe size as necessary for fittings, valves, and other concentrated loads.
- K. Hangers for horizontal lines shall be vertically adjustable to obtain pitch requirements indicated elsewhere in this specification.
- L. Hangers and supports that are in direct contact with copper shall be copper-plated or plastic-coated to prevent any electrolytic reaction.

3.3 HANGER SUPPORT INSTALLATION

- A. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulating pipe.
- B. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports to allow controlled thermal and seismic movement of piping systems to permit freedom of movement between pipe anchors and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- D. Install lateral bracing with pipe hangers and supports to prevent swaying.
- E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads including valves, flanges, strainers NPS 2-1/2"

and larger, and at changes in direction of piping. Install Concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- F. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- H. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping operating above ambient air temperature: Clamp may project through insulation.
 - b. Piping operating below ambient air temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for Power Piping and ASME B31.9 for Building Services Piping.
 - 2. Install MSS Sp-58, type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4" and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4" and larger if pipe is installed on rollers.
 - 4. Shield dimensions for pipe: not less than the following:
 - a. NPS 1/4" to NPS 3 1/2": 12" long and .048" thick.
 - b. NPS 4": 12" long and .06" thick.
 - c. NPS 5" and NPS 6": 18" long and .06" thick.
 - d. NPS 8" to NPS 14": 24" long and .075" thick.
 - e. NPS 16" to NPS 24": 24" long and .105" thick.
 - 5. Insert Material: Length at least as long as protective shield.
 - 6. Thermal-hanger Shields: Install with insulation same thickness as piping insulation.

3.4 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing to prevent swaying for equipment supports.

3.5 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, methods used in correcting welded work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

- A. Hanger adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length if continuous threaded hanger support rods to 1-1/2"

3.7 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint of miscellaneous metal are specified in Division 9 painting sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

++ END OF SECTION 233500 ++

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1.0 GENERAL

1.1 SCOPE OF WORK

- A. Provide all materials and equipment, tools, labor and supervision required to fabricate and install sheet metal ductwork, fittings, dampers and accessories as required for a complete operating air distribution system. All ductwork and systems are shown on the drawings, with material and installation specifications listed below.
- B. Provide supporting and hanging devices necessary to attach ductwork and equipment to meet all structural requirements and prevent vibration. In general, support all ductwork from structural steel above using beam clamps. Provide structural steel support for ductwork passing through walls.
- C. This Contractor shall include the following work:
 - 1. Removal of existing ductwork that is not being used by the new systems.
 - 2. Furnish and install all Supply, Return and Exhaust ductwork as shown on drawings.
 - 3. Mechanical contractor shall be responsible for all concrete core drilling and saw cutting required for the installation of the new air distribution systems.
- D. This subcontractor shall provide and install the following items as specified:
 - 1. Diffusers, registers and grilles.
 - 2. Volume dampers.
 - 3. Ductwork and duct liner
 - 4. Duct smoke detectors (Coordinate type with fire alarm subcontractor.
- E. This subcontractor shall work closely with ATC subcontractor and air balancing subcontractor during installation and start-up.
- F. This subcontractor shall provide sheet metal coordination drawings as specified.
- G. Coordinate all duct openings required in new or existing walls, floor, and roof with the Owner.
- H. This subcontractor shall provide and install additional volume dampers not shown on the drawing as deemed required by the engineer and/or Balancing Subcontractor for proper operation of the systems.
- I. This subcontractor shall perform duct leakage testing as described in this specification.

1.2 REFERENCE STANDARDS

- A. Material, construction and installation shall meet requirements of most recent editions of the following standards and references, except for more stringent requirements specified or shown on Drawings.

- B. SMACNA HVAC Duct System Design Manual (Latest Edition).
- C. SMACNA HVAC Duct Construction Standards – Metal and Flexible (Latest Edition), except as otherwise specified.
- D. SMACNA Fire, Smoke and Radiation Damper Guide for HVAC Systems (Latest Edition).
- E. SMACNA Round Industrial Duct Construction Standards (Latest Edition).
- F. SMACNA Rectangular Industrial Duct Construction Standards (Latest Edition).
- G. SMACNA HVAC Air Duct Leakage Test Manual (Latest Edition).
- H. SMACNA Seismic Restraint Manual (Latest Edition).
- I. ASTM A167-(Latest Edition): Stainless Steel Sheet.
- J. ASTM A526-(Latest Edition): Hot-Dip Zinc-Coated (Galvanized) Steel Sheet.
- K. ASTM A527-(Latest Edition): Hot-Dip Zinc-Coated (Galvanized) Steel Sheet, Lock Forming Quality.
- L. ASTM E84-(Latest Edition): Test Method for Surface Burning Characteristics of Building Materials.
- M. NFPA 90A-(Latest Edition): Installation of Air Conditioning and Ventilating Systems.
- N. NFPA 255-(Latest Edition): Test Method for Surface Burning Characteristics of Building Materials.
- O. UL 181-(Latest Edition): Factory-Made Air Ducts and Connectors.
- P. UL 723-(Latest Edition): Test Method for Surface Burning Characteristics of Building Materials.
- Q. “Industrial Ventilation” Manual of Recommended Practice (Latest Edition) published by the American Conference of Governmental Industrial Hygienists.
- R. ARI 650: Standard for Air Outlets and Inlets.
- S. AMCA 500: Test Method for Louvers, Dampers and Shutters.
- T. AWS D1.1: Structural Welding Code – Steel.
- U. ARI 880: Industry Standard for Air Terminals.
- V. IMC: 2012 International Mechanical Code with R.I. Amendments
- W. IECC: 2012 International Energy Conservation Code with R.I. Amendments.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.4 SUBMITTALS

- A. General:
1. Where deviations from contract drawings and specifications are proposed for any reason, submit shop drawings identifying proposed deviations showing layout of all ductwork, fittings, materials, gauges, dimensions, and fabrication, installation details and cost savings.
 2. The Design Professional will review deviations for pressure drop only. They will not be reviewed for clearances or for accessibility to maintain or balance the air systems. No dimensional or coordination check will be made. The Sheet Metal Subcontractor has the sole responsibility to prepare and check the contract drawings, coordinate ductwork fabrication, and provide clearances and access for installation, maintenance and balancing of this work and work of other trades. Unless specifically dimensioned, contract drawings indicate approximate locations only. The Sheet Metal Subcontractor has the sole responsibility to locate and route the ductwork. The design needs to be constructible with adequate access for maintenance.
 3. Deviations from the Contract Documents to maintain ductwork clearances or avoid structural interferences will require specific written approval from the Design Professional. The Mechanical Subcontractor must notify the Design Professional in writing referencing those conditions which deviate from the Contract Documents. Notification must be received in sufficient advance time so that revision and approval of these conditions can be made before fabrication work begins.
 4. Deviations such as changing direction or transforming or dividing ductwork must maintain ductwork cross-sectional area and not exceed transformation taper of 15 degrees.
 5. The Sheet Metal Subcontractor shall have the sole responsibility of coordinating any approved deviations as well as meeting all other design requirements of the ductwork.
- B. Sheet Metal and Accessories:
1. General: Submit the following in accordance with Conditions of Contract and Owner's requirements.
 2. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

- a. Sealing materials.
 - b. Fire-stopping materials.
3. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same as the contract drawings, detailing:
- a. Fabrication, assembly and installation details, including plans, elevations, sections, details of components and attachments to other work. Include gauge thickness schedule.
 - b. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section. Indicate materials being used, clearly differentiate between stainless steel and galvanized steel.
 - c. Fittings.
 - d. Reinforcing details and spacing.
 - e. Seam and joint construction details.
 - f. Penetrations through fire-rated and other partitions.
 - g. Terminal unit and coil installations.
 - h. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
 - i. Coordination between other trades.
 - j. Product data including details for materials, dimensions of individual components, profiles and finishes for the following items:
 - (1) Manual volume control dampers.
 - (2) Fire dampers
 - (3) Duct-mounted access panels and doors.
 - (4) Duct flexible ducts.
 - (5) Turning vanes.
 - (6) Sound Attenuators
 - (7) Duct flexible connectors.
 - (8) Duct take-off fittings
- C. Air Inlets and Outlets:
1. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - a. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size and accessories furnished.

- b. Data sheets for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
- c. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

1.5 QUALITY ASSURANCE

- A. Construct all ductwork in accordance with referenced SMACNA Standards, except as otherwise specified. Ductwork pressure classifications shall be in accordance with reference SMACNA Standards, except as otherwise specified.
- B. Round ducts and fittings shall be the product of the same manufacturer and constructed such that no dimensional variations occur to prevent proper mating between ducts and fittings, and to assure that all slip joint connections will be tight and leak-free.
- C. All ductwork shall be free from pulsation, chatter, vibration and objectionable noise. If any of these defects appear after a system is in operation, correct by removing, replacing, and/or reinforcing the ductwork, at no additional cost to the Owner.
- D. For non-welded ductwork, transverse joint connection types shall be selected by the Subcontractor and submitted to the Design Professional for approval for each separate duct type and air system based on and consistent with the static pressure class, duct leakage class, applicable sealing requirements, materials involved, duct support intervals and other provisions for proper assembly of ductwork outlined in the SMACNA HVAC Duct Construction Standards – Metal and Flexible, and the SMACNA Rectangular and Round Industrial Duct Construction Standards.
- E. Installed fittings shall be equal to those shown on the contract drawings.
- F. Where this specification indicates “minimum” ductwork gauge, thickness shall be increased as required for design pressure classification and/or governing codes.
- G. Each welder on stainless steel shall be pre-qualified to the Construction manager's satisfaction. Each welder shall be qualified by test in accordance with AWS standards. Qualification tests are to be submitted to the Construction Manager for approval, and welding is not to be started until such approval is obtained. If new welders are brought in during the job, the same procedure is to be followed for each of them. Throughout the job, a sampling of finished welds will be made for inspection. The number and selection of these will be as directed by the designated representative, based on the welder's capabilities and the requirements of the job.

1.6 LICENSES, FEES AND PERMITS

- A. Apply for, obtain and pay for all required permits and inspection certificates.
- B. The Sheet Metal Subcontractor shall be licensed to perform sheet metal work in the State of Rhode Island.

2.0 PRODUCTS

2.1 DUCTWORK AND AIR DISTRIBUTION EQUIPMENT

A. General:

1. Ductwork shall have pressure-velocity classifications per the following table based on SMACNA's latest edition of "HVAC Air Duct Leakage Test Manual."

System Identification	System Type	Pressure Class (in. w.g.)	Seal Class	Leakage Class Rectangular Ductwork	Leakage Class Round Ductwork
RTU & ACU-1	Supply	+3"	A	24	12
ACU-1	Return	-2"	A	24	12
Exhaust for all systems	Exhaust	-4"	A	24	12

* All Pittsburgh joints to be flooded with sealant during fabrication for all systems.

B. Sealing Compound and Tape

1. Ductwork in static pressure construction class of 0 to 3 inches w.g. shall be sealed with Flex-Grip #550 liquid rubber fiber reinforced as manufactured by Hardcast, Inc. or United McGill Corp. "United Duct Sealer" UL labeled meeting FDA and USDA requirements for incidental food contact.
2. All duct flanged connections shall be 1/8" thick butyl gasket as manufactured by Ward Industries Inc.
3. Duct sealant shall have a flame spread rating of 25 or less and smoke developed rating of 50 or less.
4. Exposed uninsulated ductwork shall be sealed on the inside of the ductwork with FlexGrip and clear silicon sealant on the outside in order to provide a continuous galvanized metal appearance.

C. Prefabricated Transverse Duct Joints:

1. Transverse joints in galvanized sheet metal ductwork may be submitted for approval when made with galvanized gasketed frame and angle duct joint system by Ductmate, TDF, TDC or approved equal. Angles shall be at least 20 gauge. Prefabricated transverse duct joints shall not be used for duct 16 ga. and heavier, nor for duct 23 ga. or lighter.

D. Elbow and Bends:

1. Elbows and bends for rectangular ducts shall have centerline radius of 1.5 times duct width wherever possible.
2. Where centerline radius is less than 1.5 times duct width (on supply and return ductwork), elbows shall be radius throat with radius heel and full length splitter vanes. When centerline radius (4) divided by the duct width (2) is less than 1.5, provide the following number of turning vanes: r/w between 1.49 and 0.7 = 1; r/w between 0.69 and 0.6 = 2; r/w between 0.59 and 0.55 = 3. Minimum inside radius (not centerline) shall be 2". Install vanes in accordance with SMACNA.
3. For round ductwork provide stamped elbows with centerline radii equal to 1-1/2 times duct diameter or gored elbows as follows:

<u>Elbow Angle</u>	<u>No. of Gores</u>
0° - 36°	2
37° - 72°	3
73° - 90°	5

E. Access Panels/Doors:

1. Access doors in supply & return ductwork shall be a round double wall insulated door with a gasketed steel outer frame attached and caulked to the ductwork. The access door dimension to be the maximum size allowable by the duct dimension up to a maximum 24" round door. Access doors shall be round with spin in collars, the "Inspector Series" Type SDSM, manufactured by Flexmaster. Door shall be 24 gauge while the door frame shall be 22 gauge. Provide access doors with 3 latches and cable attached from the collar to the door.

The minimum sizes are:

- Fire dampers - 16" x 12", or larger.
 - Automatic control dampers - 12" x 8" minimum.
 - At all locations as required for servicing equipment, controls, etc. - 16" x 12" minimum.
2. Generally access doors are not shown on the drawings but shall be provided in accordance with the above.

F. Materials:

1. Except as noted, all supply and return ductwork shall be constructed of hot-dipped galvanized sheet metal with G90 Commercial coating according to ASTM 527. Galvanized coating shall be a minimum of 0.90 oz./sq. ft.
2. Ductwork shall be fabricated with a minimum of horizontal surfaces for cleanliness purposes.

3. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
4. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
5. Galvanized Coating Designation: G90 (Z275).
6. Finishes for Surfaces Exposed to View: Mill phosphatized.
7. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
8. All stainless steel ductwork shall be sealed in accordance with appropriate SMACNA Seal Classification. Details and samples of joint construction and sealers must be submitted to the Engineer for approval prior to the start of work.
9. Stainless steel ductwork shall be butt-welded and free from projections or burrs on the inside and outside. Exterior welds to be ground smooth for stainless steel exposed in process areas to a No. 4 finish (180 grit). Ductwork above ceilings in chases and generally not visible shall not require external polishing.
10. Ductwork shall be fabricated with a minimum of horizontal surfaces for cleanliness purposes.
11. A minimum of 16 gauge material shall be used to provide for a clean weld. Hoods shall be constructed from 18 gauge minimum.
12. A minimum of 22 gauge shall be used for all duct systems.
13. Material Schedule

Duct Type	Material Type
All Supply & Return Air	G-90
All Exhaust Air	304 S.S. with flanged type joints. All round ductwork to be spiral round
Exterior Exhaust ductwork and stacks on Utility Fans	304 S.S. welded joints – 18 gauge minimum

G. Ductwork, Rectangular - 4" and Lower Pressure Class:

1. Ducts wider than 19" with more than 10 square feet of unbraced panel shall be beaded or cross-broken as required by SMACNA.
2. Internal stiffening rods shall only be used as allowed by SMACNA.
3. Make changes in duct size with tapered connections as required by SMACNA. Changes shall NOT exceed 30° from line of air flow. Take-off to the diffusers shall be 45 leading edge type or full radius Bellmouth type.
4. Transverse joints shall be TDF/TDC or slip joints; use flat or standing seam in accordance with SMACNA for all supply and return ductwork unless otherwise noted. Snaplock is not acceptable.
5. Longitudinal seams shall be Pittsburgh Lock in accordance with SMACNA for all supply and return ductwork unless otherwise noted. Snaplock is not acceptable.
6. Ductwork shall be constructed as indicated in the following schedule.

Duct Dimension	Duct Gauge	Joint Type	SMACNA Reinforcement Class	Stiffeners Required 2'-6" on center	Tie Rods
12" & under	24	"Double S" Slip Joint			
13" to 20"	24	TDF/TDC	C		
21" to 26"	24	TDF/TDC	D		
27" to 30"	24	TDF/TDC	E		
31" to 36"	22	TDF/TDC	F		
37" to 42"	20	TDF/TDC	G		
43" to 72"	20	TDF/TDC	H		Joint Tie Rod
73" to 96"	18	TDF/TDC	I	2"x3/16"	Joint Tie Rod
97" to 108"	16	TDF/TDC	J	2"x3/16"	Joint Tie Rod

H. Ductwork, Round - 4" and Lower Pressure Class:

1. In addition to SMACNA requirements for the appropriate service pressure, all pressure classes at 2" w.g., shall conform to the following:
 - a. Transverse joints shall be beaded sleeve joint, crimped or other approved joints listed in SMACNA. Use four or more sheet metal screws at 15" uniform intervals along the circumference of the joints.
 - b. Round ductwork 4" and lower pressure class shall be spiral round with one piece elbows. Snaplock is not acceptable.

- c. Provide the following minimum gauges from minus -4" to plus 4" water column:

3 to 26 Inches: 22 gauge
27 to 36 inches: 22 gauge
37 to 50 inches: 20 gauge
52 to 60 inches: 18 gauge
82 to 84 inches: 16 gauge

I. Volume Dampers:

1. Provide manual adjustable volume dampers with extended mount indicating and locking quadrants:
 - a. At each take-off to grille (not all are shown on drawings).
2. For Seal Class B, penetrations shall be provided with sealed assemblies, Ventlok HIVEL 641 and HIVEL 609 end bearing or approved equal. For insulated ducts provide proper assembly.
3. Dampers shall be 1/2" smaller in both dimensions or 1" smaller diameter than size of duct in which they are installed; e.g. use 23-1/2" by 23-1/2" damper for 24" square duct.
4. Dampers larger than 12" in height shall be opposed multi-blade equal to Ruskin MD-35. Dampers smaller than 12" shall be single blade equal to Ruskin MD25.
5. Damper blades shall be two gauges heavier than adjoining ductwork and shall be riveted to supporting rods. Hem over edges parallel to rods.
6. Brackets shall be galvanized metal secured to ductwork with sheetmetal screw with locking quadrant arms (see seal class section for additional requirements). Provide 2" handle extension for all dampers to raise above the duct insulation.
7. Note: All required volume dampers may not be indicated on Drawings, but dampers shall be provided as necessary for system balancing.
8. All round manual balancing dampers shall be equal to Ruskin MDRS25.

J. Duct Take-offs & Miscellaneous fittings

1. Duct take-offs shall be tapered, bellmouth or conical. No straight taps or spin-in connections are permitted. All take-offs shall be a minimum of 26 gauge. Dampers shall not be included. Dampers will be installed outside of the fitting with elevated dial regulator as specified elsewhere in this specification. Provide self adhesive gasketing seal around perimeter at connection point.
2. For 2" and lower pressure class utilize Buckley Model # 3300 - 45 degree take-off fitting without the damper. Dampers shall not be included. Dampers will be installed outside of the fitting with elevated dial regulator as specified elsewhere in this specification.

- K. Bellmouth Take-offs
 - 3. Subcontractor shall provide Buckley Bellmouth Take-offs, or equal, at all round branch duct locations. All listed model numbers are based on Buckley.
 - 4. Bellmouth fitting shall be Model BM. In areas where sufficient duct height is not available, the Subcontractor shall provide the Buckley Mini-mouth fitting, Model M-BM, the flat oval Bellmouth, Model FOBM or rectangular Bellmouth Model #RMB.
 - 5. Bellmouths shall be constructed of heavy-duty galvanized steel. Bellmouths shall include an air-tight neoprene gasket to ensure a tight fitting with minimal leakage. Pre-drilled holes shall be provided for quick mounting.
 - 6. Provide dampers where indicated on the drawings. Damper construction shall meet the criteria specified elsewhere in this section.

2.2 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards. Turning vanes shall be installed in all mitered elbows & tees.
- B. Manufactured Turning Vanes: Fabrication of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.
- C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fiberglass fill.
- D. Provide turning vanes in accordance with the following schedule:

<u>Diameter (Inches)</u>	<u>Number of Vanes</u>
3 thru 9	2
10 thru 14	3
15 thru 19	4
20 thru 36	5

2.3 DUCT FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings and adhesives complying with UL Standard 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 2-3/4 inch-wide, 24-gauge galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connection duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition.

2.4 MOTORIZED DAMPERS

- A. Outside air damper shall be Ruskin CD60 dampers. Damper blades shall be airfoil blade design. Damper blades shall be constructed of minimum 14 gauge galvanized steel and damper frames of minimum 16 gauge galvanized steel. Blades shall rotate on stainless steel

sleeve bearings. All linkage shall be out of air stream. Provide opposed blade arrangement with metal compressible jam seals and extruded santoprene blade edge seal. Leakage rate shall not exceed 4 CFM/square foot at one inch water gage and 8 CFM/square foot at four inches water gage. Leakage and pressure ratings shall be based on AMCA publication 500.

- B. Provide mechanical linkage between multiple dampers as required. Actuator shall be provided and installed by ATC Subcontractor.

2.5 AIR INLETS AND OUTLETS

- A. Register, Grilles, and Diffusers
 - 1. General
 - a. Supply and return grilles shall be of sizes, types and capacities, noise criteria (NC ratings), pressure drops, neck sizes, etc., as shown on the schedules and specified.
 - b. Grilles shall be coordinated with the existing ceiling layout and cable tray.
 - c. Edge style shall be coordinated with type of ceiling in which installed.

2.6 SLEEVES AND PENETRATIONS

- A. Duct Sleeves and Openings:
 - 1. Openings in walls, partitions and other fire-rated construction shall meet NFPA 90A.
 - 2. Materials for prepared openings in partitions shall match construction penetrated.
 - 3. Subcontractor shall be responsible for coordinating opening sizes and locations in all walls (new and existing), floors, and roof with the Owner during construction.

2.7 DUCTWORK HANGERS AND SUPPORTS

- A. Miscellaneous materials for support of all ducts shall be provided and installed.
- B. Ductwork fasteners, anchors, tie-rods, straps, trim and structural angles shall be hot-dipped galvanized steel for galvanized ductwork. Factory strut-type raceways and fittings shall be allowed in lieu of structural angles.
- C. All metal parts that are not galvanized, stainless or aluminum shall be cleaned and painted with two (2) coats of Porter No. 298N gray alkyd oil primer.
- D. Provide & install Seismic restraints as required. If local codes and authorities having jurisdiction require more stringent materials and methods, those shall apply instead.
- E. Maximum support spacing shall not exceed eight (8) feet.

- F. All ducts shall be supported by structural angle and steel rods unless otherwise indicated in this specification. All duct lower attachments shall be supported with two nuts locked-in-place under the angle.
- G. Upper portion of the hanger rod shall be attached to the steel structure utilizing C-clamps, Grinnel Fig. 47, malleable iron clamp, hardened steel cup point set screw, with retaining clip Fig. 22 or 192RS.
- H. Contractor shall coordinate duct hangers and supports to avoid conflicts with piping, electrical conduits, lights and all work of other trades.

2.8 SEISMIC RESTRAINTS FOR DUCTWORK

- A. Seismic restraints, as required shall be designed and certified by a structural engineer licensed within the state in which the work is to be installed.
- B. Seismic restraints shall be provided for all ductwork with the exception of the following:
 - 1. Ductwork suspended by individual hangers 12 inches or less from the top of the duct to the supporting structure.
 - 2. Ductwork which has a cross-sectional area less than six (6) square feet.
- C. All ductwork shall be two point independently braced with multiple steel cable type with approved fastening device to duct support and structure. System to be field bolted to deck or overhead structural members using two-sided beam clamps.
- D. All vibration isolation and seismic devices shall be the product of a single manufacturer. Mason Industries in the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the base manufacturer.

2.9 FIRE STOPPING

- A. Fire-Resistant Sealant: provide two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratories, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

2.10 DUCTWORK IDENTIFICATION

- A. Ductwork shall be stenciled at each junction or branch takeoff, at least once in each room, and at intervals not longer than 20 ft. Stencil shall clearly identify duct service (S for supply, R for return, X for exhaust), area served by branch, and arrow indicating direction of flow. (Exception – Exposed polished stainless steel shall not be stenciled or in any manner defaced for purposes of identification.)

- B. Mains shall be labeled at points of entrance and exit from mechanical room, adjacent to each air valve, on each riser, at each tee fitting, at points of entrance and exit from building, at least once in each room, and at intervals no longer than 20 ft.
- C. Size of legend letters on markers and length of color field shall be per the latest addition of ANSI A13.1.
- D. Markers shall be "Setmark" by Seton Name Plate Corp. or approved equal.
- E. Color banding shall meet latest edition of ANSI A13.1 and OSHA.

2.11 EXHAUST FAN DISCHARGE STACKS

- A. All bracing shall be external to stacks (internal bracing will be allowed for shipping and erection as long as it is removed after erection). Stacks shall be all welded 304 stainless steel. Stacks shall be fabricated and self-supporting without the use of guy wires.
 - 1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - 2. Guy wires shall be installed as indicated on the contract drawings. This contractor shall be responsible for connection the guy wires into the structural steel of the bldg. and flashing the support rods liquid tight.

3.0 EXECUTION

3.1 GENERAL

- A. Cooperate and coordinate with work of other sections in executing work of this section.
- B. All work shall be done in a neat and workman like manner.
- C. Ductwork shall be installed as high as possible. Ducts shall be run parallel to building columns and column lines. Diagonal runs shall be made only with Engineer's prior approval.
- D. Ductwork shall not vibrate, rattle or drum when subjected to full volume air flow.
- E. Cleaning:
 - 1. Temporary openings in ductwork shall be sealed immediately following installation to exclude dirt and moisture.
 - 2. Before operating air handling system, debris and dirt shall be removed from plenums and ducts by vacuum cleaning.
 - 3. After fans have been operated, debris and dirt in plenums and air handling units shall again be removed by vacuum cleaning or otherwise.

4. Following cleaning as specified above, filters shall be replaced with clean filters (new filters where throwaway type were initially installed, and newly cleaned where permanent type were installed).
 5. Duct systems shall be left clean and in good condition to receive paint or insulation.
- F. Make ductwork alterations required to permit or facilitate HVAC system balancing, and ductwork alterations required as a result of balancing, including additional dampers, splitting vanes, and anti-turbulence devices.

3.2 DUCTWORK AND DUCT ACCESSORIES

A. General:

1. Ductwork shall be free from vibration under all conditions of operation.
2. When making offsets and transformations necessary to accommodate structural conditions, preserve full cross-sectional area of ductwork as shown on Drawings.
3. No sharp metal edges shall extend into air streams. The inside edge of slip joints shall be placed to face in the direction of airflow.
4. Air extractors, splitters, and air scoops shall not be used.

B. Joints, Elbows and Bends:

1. Longitudinal lock seams shall be double-locked and flattened to make tight joints.
2. Make transverse joints, field connections, collar attachments and flexible connections to ducts and equipment with sheet metal screws or bolts and nuts. Do not use rivets and staples.
3. Transverse joints in galvanized sheet metal ductwork may be submitted for approval when made with galvanized gasketed frame and angle duct joint system by Ductmate, TDF, TDC or approved equal. Angles shall be at least 20 gauge.
4. Secure angles to duct with screws (using clutched arbor) or spot-welds spaced as recommended by manufacturer for duct pressure class.
5. Elbows and bends for rectangular ducts shall have centerline radius of 1.5 times duct width wherever possible.
6. All rectangular elbows shall be long radius type. Mitered rectangular elbows with turning vanes shall not be permitted unless approved by the engineer or indicated on the contract documents.
7. As a general rule if mitered elbows or tee fittings are indicated on the contract documents, double width turning vanes shall be installed.

C. Flexible Ductwork:

1. Provide supports at manufacturer's recommended intervals. Sag shall not exceed ½" per foot of spacing between supports. Ducts shall not exceed 5 feet long and shall be used for straight run only, no offsets or turns.
 2. Hanger and saddle in contact with flexible duct shall be wide enough to prevent restriction of internal duct diameter when weight of supported section rests on hanger or saddle material.
 3. Factory-installed suspension system integral to flexible duct are acceptable as alternative hanging method when manufacturer's recommended procedures are followed.
 4. Collars to which flexible ducts are attached shall be at least 2" long. Sleeves for joining sections of flexible duct shall be at least 4" long.
 5. Apply sealing compound to metallic surface at connection of flexible duct with sheet metal ducts, collars and mixing boxes. Slip flexible ductwork over sealing compound. Complete seal with 1/2" wide, commercially made metal draw bands.
- D. Air Outlets and Inlets:
1. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended function.
 2. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
 3. Furnish to Owner, with receipt, three (3) operating keys for each type of air outlet and inlet that require them.

3.3 FITTING INSTALLATION

- A. Where applicable, use minimum of six (6) sheet metal screws per joint.
- B. Apply approved sealant on duct-to-duct joint before assembly. Apply additional sealant after assembly to make joint airtight. Where applicable, heat-shrinkable plastic bands may be substituted for sealant.
- C. Where male and female joints are specified for round ducts, install male into female in direction of air flow. When assembling, apply an approved synthetic rubber sealing compound on the outside of the duct to make these joints airtight. Heat-shrinkable plastic bands may be substituted for sealing compound. Mechanically fasten conduits together using a minimum of six (6) sheet metal screws per fitting joint.

3.4 PENETRATIONS

- A. Where ducts pass through walls, floors, or partitions required to have a fire resistance rating and fire dampers are not required, the opening in the construction around the duct shall not exceed one inch average clearance on all sides and shall be filled solidly with an approved material, capable of preventing the passage of flame and hot gases. Provide angle collars

and/or galvanized sheet metal safing as required to cover gap between ductwork and opening. Angle collars shall be required when safing is used for duct support at floors.

- B. Where ducts pass through walls, floors, or partitions required to have a fire resistance rating and fire dampers are required, the ductwork shall not be installed continuous through the opening in the construction, but shall connect on each side of the opening to a damper installed in a sleeve or frame secured by perimeter mounting angles on both sides of the opening. For specific details regarding sleeve thickness, perimeter angle dimensions, size and frequency of fasteners, clearance for expansion, duct-sleeve connections, and fire damper access doors, refer to SMACNA Fire, Smoke and Radiation Damper Guide for HVAC Systems, NFPA 90A and damper manufacturer's installation instructions.
- C. Where ducts pass through walls, floors, or partitions not required to have a fire resistance rating, the opening in the construction shall be packed with mineral fireproofing and sealed on both sides with an approved material. Provide angle collars and/or galvanized steel sheet metal safing as required to cover gap between ductwork and opening. Angle collars shall be required when safing is used for duct support at floors.
- D. Penetrations through roof and outside walls shall be caulked air and water tight on both sides of penetration. Provide all counter flashing of ducts which pass through walls, roofs, etc., to the outdoors. The penetration shall be large enough to allow ductwork and insulation to pass thru. There shall be no breaks in the ductwork insulation.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Support ductwork hung from building structure using Unistrut or angle iron hangers conforming to SMACNA HVAC Duct Construction Standards – Metal and Flexible. Strap hangers are not acceptable. Provide supplemental structural steel to span joists where required. Deflection of supplemental structural steel shall be limited to 1/180 of the span. Support ductwork from floor on angle iron frame with metal base plates only where shown on drawings. All duct lower attachments shall be supported with two nuts locked in place under the Unistrut or angle. All duct upper attachments shall utilize C-clamps as described in Part 2.0.
- B. Do not support ductwork from furring, hung ceilings, metal pan roof or from another duct or pipe.
- C. Do not use perforated band iron.
- D. Support ductwork at each change in direction.
- E. Where vertical ducts penetrate floor openings, provide two horizontal galvanized steel angle supports attached to the long side of the duct and anchored to the floor with expansion bolts. Where possible, extend angles 3 inches beyond edge of opening. Provide the following angle sizes:

<u>Duct Size (Inches)</u>	<u>Angle Size (Inches)</u>
Thru 36	1-1/4 x 1-1/4 x 1/8
37 thru 59	2 x 2 x 3/16

- F. Where duct connects to or terminates at masonry openings or at floors where concrete curbs are not used, provide a continuous 1-1/2" x 1-1/2" x 3/16" galvanized steel angle support around the ductwork. Bolt and seal the supports to the building construction using expansion bolts and caulking compound. Seal shall be water tight at floor and cut such that a water spill will not pass down through floor opening.
- G. For exterior duct supports, provide two full-height vertical angle supports with welded base plates anchored to steel, concrete roof or roof supports as required. Add horizontal angles at top and bottom of duct. Weld angles together to form a rigid continuous support for the ductwork.
- H. Support insulated ducts on the outside of the insulation. To maintain the insulation value, insert a piece of 1 inch thick, 6 pcf fiberglass board at these supports.
- I. Space hangers as required by SMACNA (8 ft. max.) for horizontal duct on 8 ft. centers, unless concentrated loadings require closer spacing.
- J. Supports for ductwork and equipment shall be galvanized unless otherwise noted. Supports for exposed ductwork in process areas shall be stainless steel. Threaded rod is not acceptable as exposed within process areas.
- K. Ducts over 48" wide shall be braced by angle on bottom side.
- L. For cross sectional area more than 8 sq. ft., duct shall be braced by angles on all four sides.
- M. All ductwork shall be provided with seismic restraints in accordance with the seismic hazard level of the seismic restraint manual: Guidelines for Mechanical Systems (latest edition) as published by the Sheet Metal and Air Conditioning Subcontractors National Association, Inc., and in accordance with local codes.
- N. For 2" pressure class ductwork that is 18"x18" or less sheet metal strapping in strict accordance with SMACNA guidelines can be utilized.
- O. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

3.6 SEALING AND TAPE

- A. Make seams and joints airtight with sealants.
- B. Install the sealants in accordance with sealant manufacturer's instructions and recommendation.
- C. Seal ductwork seams, joints, fastener penetrations and fitting connections with sealants in accordance with SMACNA Seal Classification.
- D. Completely fill all voids when liquid sealing ductwork. Several applications may be necessary to fill voids caused by shrinkage or runout of sealant.
- E. Apply mastic sealers by pressure gun to the inside of the female joint prior to assembly so that the air pressure forces the sealant into the voids.

- F. Install sealing tape in strict conformance with manufacturer's instructions and recommendations.

3.7 CLEANLINESS OF DUCTWORK

- A. The subcontractor shall maintain a clean work area and dispose of work generated debris. Before any equipment or ductwork is installed, it shall be inspected and cleaned, if necessary, to minimize introduction of foreign material and contaminants to airstream and space. In addition, certain pieces of equipment are to be vacuumed prior to placing in operation. Refer to individual equipment specifications for requirements.
- B. All ductwork shall be shipped to the job site clean and oil-free. The subcontractor shall ensure that ductwork is kept clean during shipment to the job site, while being stored on-site, and during installation. Immediately prior to installation, the interior and exterior of each duct section shall be cleaned. Cleaning shall include as a minimum, but not be limited to, wiping down all duct surfaces with a clean, cotton cloth to remove dirt and oil from the surfaces. At the end of each workday, the subcontractor shall temporarily seal open ends of ductwork (and openings into ductwork). Temporary sealing shall be by means of heavy mil polyethylene film securely taped to duct to prevent introduction of foreign material, e.g., construction debris, into the duct systems. All openings and open ends of ductwork shall remain sealed until connected to additional duct and/or equipment.
- C. Cleanliness of ductwork shall utilize the Basic Duct Cleanliness Level as described in SMACNA "Duct Cleanliness for New Construction" Manual.

3.8 DELIVERY, STORAGE AND HANDLING

- A. All ductwork shall be delivered, stored and handled with ends sealed with metal or polyethylene wrap to ensure cleanliness. Ductwork shall be protected from the weather. Deliver ductwork in enclosed trucks during rain or snow conditions.
- B. Deliver sealant and fire-stopping materials to site in original unopened container or bundles with labels informing about manufacturer, product name and designation, color, expiration period of use, pot life, curing time, and mixing instructions for multi-component materials.
- C. Store and handle sealant fire-stopping materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- D. The sheet metal subcontractor is fully responsible for all materials stored on the site.

3.9 WELDED DUCTWORK – STAINLESS STEEL

- A. Ductwork and fittings shall be 16 gauge minimum.
- B. Stainless steel hoods shall be constructed from 18 gauge minimum.

- C. Bracing, reinforcement and all ductwork accessories such as balancing dampers, fire dampers, etc. shall be stainless steel.
- D. All exposed hangers in the room shall be constructed in accordance with the ductwork and meet the same requirement for appearance.
- E. Welding shall be the Tungsten Inert Gas (TIG) Method and shall conform to the requirements of the American Welding Society AWS 9.1-90 specification for welding of sheet metal.
- F. Welding equipment shall be of a size and type suitable for the work and shall be maintained in such a condition as to ensure acceptable welds.
- G. Electrodes shall be 1/16" diameter thoriated tungsten conforming to AWS-ASTM, ESTh2 classification. They are to be sharpened as required and re-sharpened often enough to keep them clean. The electric current for welding shall be direct current, straight polarity (electrode negative). Voltages and amperes chosen must be within the recommended range as provided by the electrode manufacturer and produce welds of acceptable quality. All welds shall be shielded with welding grade argon at a controlled rate through a flow meter. Duct is to be welded in one pass, using no filler metal.
- H. Just before starting a weld, the sheet metal must be cleaned. This cleaning shall be accomplished by mechanical means. No grease, oil, duct, dirt, paint, sugar, or other contaminating materials may be left on the ductwork. Welders shall use clean gloves when handling the sheet metal and filler metal.
- I. Ends of ductwork shall be carefully aligned so as to have the least possible misalignment and offset. Alignment should be re-checked after tacking. All internal and external shielding requirements shall apply to tacking as well as to welding. All tacks shall be carefully cleaned before welding proceeds.
- J. Automatic welding is preferred for all shop welds. All welds on stainless steel material must be made to minimize carbide precipitation and stress.
- K. Inspection of welds shall be visual in accordance with AWS Standard D9.1. The completed weld is to be smooth and even, with as little build-up or undercut as possible. The weld must be free of pits, crevices, and cracks. There must be complete fusion. If polished or finished welds are required, the finish must be blended to match the finish of the adjacent duct. No finishing operation may be allowed to cut into the weld in such a way as to weaken it or cause leakage.
- L. All welds inside the room below the ceiling shall be ground and polished with a non-carbon type wheel, to achieve a bright aesthetic appearance.

3.10 DUCTWORK LEAKAGE TESTING

- A. Each system shall be tested by the HVAC subcontractor for leakage at 125% of the designated operating pressure. Test procedure shall be in accordance with SMACNA "HVAC Air Duct Leakage Test Manual." Prior to performing any leakage tests, the subcontractor shall submit written test procedure and certified calibration data on the equipment used for testing. Tests shall be performed with access doors installed and prior

to insulating duct or before ducts are concealed by building enclosures. Refer to Section 2.1 for duct pressure classification.

- B. Acceptance: Maximum allowable leakage shall not exceed the CFM/SQ. FT. listed in the SMACNA "HVAC Air Duct Leakage Test Manual" Figure 4-1. utilizing the seal and leakage classes indicated in Section 2.1
- C. Witness, approval, reporting. Each pressure test shall be witnessed by a representative of the Construction Manager. Subcontractor shall obtain approval from Construction Manager and Owner prior to proceeding with any further work. Reports showing both initial and final test results, signed by the subcontractor, the Construction Manager, and Owner representatives, shall be submitted to the Engineer for record purposes. Reports shall be on standard SMACNA forms.
- D. The Sheet Metal Subcontractor shall keep an up-to-date log of the ductwork tested for review by the Engineer. The Sheet Metal Subcontractor shall notify all other subcontractors when the testing is completed and accepted to permit enclosure of ducts.
- E. The Sheet Metal Subcontractor shall furnish and install all blank off plates, blind flanges, safing, etc., necessary to isolate each section of duct being tested for leakage.
- F. The Sheet Metal Subcontractor shall submit for review all proposed testing procedures and equipment to the Engineer prior to proceeding. Additionally, the Sheet Metal Subcontractor shall notify the Engineer when testing is to occur so that the test can be witnessed at the Engineer's option. All documentation shall refer to a ductwork plan that associates each section tested with a highlighted plan showing that section.
- G. All test equipment shall be calibrated per ANSI standards prior to testing. Certified test reports shall be submitted to the Engineer prior to commencement of the testing.
- H. All instruments used to test ductwork shall have calibrated certifications certified within one year at last use.
- I. **All new exterior supply, return and exhaust ductwork shall be leak tested before it is insulated. Install all ductwork with support attached and sealed before testing. Blank off ductwork at the RTU, ACU or EF connections and blank off the ductwork at the bldg.. entrance so that all the new exterior ductwork can be pressurized before it is insulated. Test ductwork to 3" static pressure.**

+ + END OF SECTION 236800 + +

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1.0 GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This section includes units with integral Direct Gas-Fired heating Airflow arrangement shall be Outdoor Air only. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in Section 2 of this specification.
- B. Related sections include the following:
 - 1. Section 23 0000: Scope of Work
 - 2. Section 23 0400: Plumbing
 - 3. Section 23 9500: Controls and Instrumentation
 - 4. Electrical Specifications
 - 5. Structural Specifications

1.2 SUBMITTALS

- A. General: Submit each item in this Article according to the conditions of the Contract and Specification Section 15000 "General Requirements for HVAC Systems".
- B. Product data for each central-station air-handling unit specified, including the following:
 - 1. Certified fan-performance curves with system operating conditions indicated as tested in an AMCA Certified Chamber.
 - 2. Certified fan-sound power ratings.
 - 3. Certified coil-performance ratings with system operating conditions indicated.
 - 4. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 5. Material gages and finishes.
 - 6. Filters with performance characteristics.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Certified burner performance ratings with system operating conditions indicated.
 - 9. All accessories being provided.
- C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- D. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
- E. Coordination Drawings, including floor plans and sections drawn to scale. Submit with Shop Drawings. Show mechanical-room layout and relationships between components and

adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

- F. Maintenance data for central-station air-handling units shall be included in the operation and maintenance manuals specified in Division 15 Section "General Requirements for HVAC Systems".
- G. Network Interface Controller specifications to include available options and operating protocols. Include complete data on all factory-supplied input devices.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Central-station air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
- B. UL Compliance: Electric coils, along with complete central-station air-handling unit, shall be listed and labeled by UL.
- C. ARI Certification: Central-station air-handling units and their components shall be factory tested according to the applicable portions of ARI 430, "Central-Station Air-Handling Units," and shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute (ARI).
- D. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.
- E. Comply with NFPA 70 for components and installation.
- F. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- G. Source Limitations: Obtain Packaged Make-Up Air Unit with Integral Heating with all appurtenant components or accessories from a single manufacturer.
- H. Product Options: Drawings must indicate size, profiles and dimensional requirements of Make-Up Air Units and are to be based on the specific system indicated.
- I. Certifications:
 - 1. Entire unit shall be ETL Certified per ANSI Z83.4 or ANSI Z83.18 and bear an ETL

mark.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver RTU as a single unit for field fabrication with protective crating and covering.
- B. Lift and support units with manufacturer's designated lifting or supporting point.

1.5 SEQUENCING AND SCHEDULING

- A. Mechanical Contractor shall coordinate size and location of all roof steel dunnage with steel sub-contractor. Review of steel shop drawings for exact location of steel members shall be the responsibility of this contractor. Any re-work of the steel due to not reviewing the submittal or not providing the proper/correct information will result in a back charge to this contractor.
- B. Coordinate sequencing of construction of associated plumbing, HVAC, and electrical supply.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
- B. Filters: Furnish 2 sets (pre-filter and final) for each central-station air-handling unit.
- C. Fan Belts: Furnish 1 set for each central-station air-handling unit fan.
- D. Gaskets: Furnish 1 for each sectional joint of each central-station air-handling unit.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation (Design Basis)
 - 2. Trane Company
 - 3. Sterling

Note: Manufacturers are listed as acceptable only if they meet the performance and specification construction requirements. This contractor shall ensure that non design basis vendors meet all the requirements of the specs and drawings before submitting to the Engineer for Approval. Any cost delays to the project due to rejected

submittals will be back charged to this contractor.

2.2 UNIT STRUCTURE

- A. Structural base shall be of 10 gauge hot-dipped galvanized steel and include a welded base channel for mounting to a structural steel framing system. Cabinet framing and supports shall be at least 14 gauge galvanized steel and shall provide sufficient rigidity for top-handling through eye-bolts without the use of on-site "spreader bars". Outer casing shall over-lap the base frame at all surfaces to provide weather-tight flashing and shall be attached with gasketed mechanical fasteners. These fasteners shall be field removable using simple hand tools. Top panels shall be supported from within by structural members and shall be so shaped as to drain water to the outer edge for run-off.
- B. All major sections and/or accessories are to be equipped with matching external flanges provided with neoprene gasketing material. Job site attachment of sections shall be with 1/4" - 20 bolts, nuts or self-drilling screws, and neoprene seal washers provided by the equipment manufacturer and installed through pre-drilled matching holes in the connecting flanges. Base frames shall have heavy gauge "bolt tabs" so that sections may be pulled tightly together without the use of pipe clamps or related equipment by the installer. Unit will be shipped in major sections; heater blower section, filter and intake damper section, intake hood section.

2.3 CASING

- A. General:
 - 1. Unit shall be completely weather-tight designed for outdoor installation. The casing shall be able to withstand up to 1.5 times design static pressure or 8" w.c. whichever is less, with no more than 0.005 inch deflection per inch of panel span.
 - 2. Unit roof shall be sloped a minimum of .25" per foot either from one side or unit to other, or from center to sides of the unit.
- B. Unit casing of all sections shall be double wall construction with solid wall G-90 galvanized steel liner. The exterior casing shall be constructed of minimum 18 gauge G-90 galvanized steel panels with a minimum thickness of 0.055" welded to minimum 10 gauge unit structure with entire unit supported by a structural base. The interior liner shall be constructed of 24 gauge G-90 galvanized steel panels. All welds to be coated with zinc chromate paint or equal. Manufacturer must provide lifting brackets for field rigging of unit or unit sections.
- C. Unit insulation required in all sections.
- D. Insulate casing sections with 1 inch - 1.5 pound per cubic foot density fiber glass insulation or 1 inch - 3 pound per cubic foot density fiberglass insulation with an R value of 7.69 F sq. ft. h/Btu. Insulation shall conform to NFPA 90A.
- E. Provide insulated double wall access doors of sufficient size to permit entry into unit casing.

Doors to be constructed of same material as casing, with gasket, OSHA approved industrial style latches that can be opened from the inside or outside of unit, and hinges. Doors attached by screws or not continuously gasketed shall not be permitted.

1. Access doors shall be provided at burner/controls, fan, evaporator, heat recovery coil section, and filter service area. These doors shall seat in a 5/8" wide gasketed "U"-channel and shall be readily removable without the use of any tool.
- F. Provide paneled bottom – sheet metal liner for base insulation.
- G. Provide all corrosion resistant fasteners.

2.4 Fans

- A. Fans used shall not decrease motor size, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent. Housings shall be adequately braced, and designed to minimize turbulence with spun inlet bell and shaped cut-off.
- B. Provide self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to drive side of fan with plastic tube and grease fitting rigidly attached to fan supporting members. Bearing shall be rated for L-50 life of 200,000 hours.
- C. Fan and motor shall be internally mounted on common base. Provide access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators. 1.125" spring isolators shall be supplied for the supply fans. Isolators shall be rated for 1 inch static deflection, with side snubbers.
- D. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor power. Fan wheel shall be double-width, double-inlet type with forward or backward-curved airfoil blades as indicated on schedule.
1. Backward Inclined: Steel or aluminum construction with curved inlet flange, back plate, backward-curved blades, and cast-iron or cast-steel hub.
 2. Airfoil Wheel: Steel; with smooth, curved inlet flange; back plate; die-formed, hollow, airfoil blades; and cast-iron or cast-steel hub.
- E. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower and must have neoprene vibration isolation devices, minimum of 1-1/8 inches thick.
- F. Fan: Backward Curve plenum fan statically and dynamically balanced, AMCA certified for air and sound performance.
- G. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

2.5. MOTORS AND DRIVE

- A. Fan motor(s) shall be Inverter Duty with 1600V insulation, operable at 460 Volts, 60 Hz, 3-phase. Motor shall be controlled by a variable frequency drive provided and installed by unit manufacturer. See VFD requirements in this spec. Motor shall have shaft grounding rings. The VFD compartment shall be provided with A/C and heat as needed for the VFD to properly operate within the manufacturers ambient condition requirements.
- B. Direct-drive fan(s): Blower assembly shall consist of an electric motor as specified by Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on minimum 1.125 inch thick neoprene vibration isolators. Blower motor(s) shall be capable of continuous speed modulation and controlled by a factory supplied VFD.
- C. General: Blower motors greater than 3/4 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase, and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley.

2.6 DIRECT GAS HEATING SECTION

- A. Unit shall be factory assembled, piped, and wired. Direct gas-fired system will be 92% efficient while supplying a burner that is capable of providing 25:1 turndown. Unit will utilize a draw through design and incorporate adjustable burner baffles plates for field adjustments. Unit will have a Pilot ignition system.
- B. Burner construction shall consist of a cast aluminum burner manifold and 409 series stainless steel mixing plates. No air from inside the space shall be allowed to pass across the burner at any time. Flame sensing shall be provided by a flame rod. Burner control shall have a digital coded fault indicator capable of storing the last five faults.
- C. Shall be equipped for operation on Natural gas with a maximum rated inlet gas pressure of 5 PSI. 2 PSI to be provided from site.
- E. Shall include the following safety controls:
 - a. Manual Reset, High Limit Switch: Main gas valve closes if high-limit temperature is exceeded.
 - b. Dual safety shutoff valves shall be provided that do not exceed 120 VAC control signals.
 - c. High Gas Pressure Switch(es): Main gas valve closes if high pressure switch defaults.
 - d. Flame Sensing – Flame Rod
 - e. Low Gas Pressure Switch
 - f. ETL and IRI Agency Approval

2.8 FILTERS

- A. Provide filter rack of galvanized steel with filter guides and blockoffs as required to prevent air bypass. Access to filters shall be side access for easy filter service.
- B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.
- C. Unit shall have 2" thick MERV 8 disposable pleated filters following the outdoor air intake in a V-bank arrangement and shall be accessible from the exterior of the unit.
- D. Provide (2) sets of filters per unit – (1) set shipped loose.

2.10 UNIT CONTROLS

- A. Temperature control shall be controlled by a duct mounted discharge air controller provided and installed by the DDC controls contractor.
- B. The systems airflow shall be controlled by a duct mounted static pressure sensor and motor variable frequency drive provided and installed by the ATC contractor.
- C. Excepting thermostat, all controls shall be factory installed, including the safety control. Required motor starter, relays, transformers, switches, fuse holders, and sequencing controls shall be factory wired with suitable conduit and mounted in adequate enclosures of approved type. A combination fan and limit control shall control the main blowers and operate to de-energize the burner if discharge air temperature becomes excessive.
- D. The unit shall be constructed so that it can function as a stand-alone heating system controlled by a factory-supplied remote panel, thermostats and sensors or it can be operated as a heating system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed Network interface controller that is connected to various optional sensors.
- E. Unit shall incorporate a Network interface controller with integral LCD screen that provides text readouts of status, operating settings, and alarm conditions. Network interface controller shall have a built in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices, or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.
- F. Operating protocol: The Network interface controller shall be supplied with a protocol card for BACnet MS/TP for monitoring of the unit's status.

- G. Variable Frequency Drive (VFD): Unit shall have factory installed variable frequency drives for modulation of the blower motors. The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
- H. Sensors to be provided with the unit:
 - 1. Heating Inlet Air Sensor
 - 2. Dirty Filter Sensor
 - 3. Freeze Protection (Supply Air Low Limit)
 - 4. Inlet Air Damper End Switch
 - 5. Discharge Air Control
- I. Provide additional control relays and normally open dry contacts wired to terminals for interlocking into the existing DDC control system. Provide as a minimum:
 - 1. Control Voltage Power On
 - 2. Outside Air Damper Open
 - 3. Main Blower On
 - 4. Low Gas Pressure
 - 5. High Gas Pressure
 - 6. Heat On
 - 7. Heat Failure
 - 8. Dirty filter indication.
 - 9. Airflow Proving Monitoring Contact

2.11 UNIT ACCESSORIES

- A. NEMA-3R weatherproof disconnect switch.
- B. Step down transformer.
- C. Intake damper with low leakage dampers and end switches. Leakage rate shall not exceed 3 cfm/foot² at 1 inch w.g. Class 1A.
- D. Intake hood with bird screen.
- E. Convenience outlet, weather-resistant service light and transformer (enclosed and gasketed), vapor-tight light fixture shall be provided in each fan, coil, filter, and access sections. Fixture shall be complete with junction box, globe, aluminum globe guard, switch, receptacle and bulb.
- F. Factory test check and start-up of unit at job site by an authorized service person.
- G. 10 year burner warranty.
- H. 2 year parts and labor warranty on entire unit.
- I. Unit color to be selected by the Owner/Engineer at the submittal stage of the project. Exterior factory paint shall be able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours.
- J. Hinged Access Doors
- K. BMS Protocol – BACnet MSTP
- L. Supply Fan Control to maintain a constant CFM via HZ setting as measured by the air balancer.

2.5 VARIABLE FREQUENCY DRIVES

- A. Summary
 - 1. Work Includes: furnish variable frequency drives (constant and variable torque) for NEMA T-Frame motors as shown on the Drawings:
 - a. up to 250 HP
 - b. 208, 240 and 480 Volt
 - c. 3-phase
 - d. 60 Hz
 - 2. Variable frequency drives shall be of sufficient capacity and provide quality output waveform to achieve full rated output of the motors.

3. The Owner reserves the right to award a single complete order, or award separate orders for the Variable Frequency Drive Controller(s).

B. Submittals

1. Completed Material Data Sheets for variable frequency drive controllers and other options.
2. Nominal dimensions
3. Weight
4. Typical efficiency vs. speed graphs for variable torque load
5. The amount of harmonic distortion contributed to the motor and the electrical system
6. Available NEMA enclosure types
7. List of spare parts containing part numbers, description and price of each
8. Outline of the extent of the training that is available for the maintenance electricians. This training will include training to the level of replacing printed circuit boards to drive testing and calibration. This outline shall include the cost to Abbott either per person or per session.
9. All options being provided.

C. Codes and Standards

1. Variable frequency drives shall be designed, tested and assembled in accordance with the latest applicable standards of:
 - a. IEC International Electrical Code
 - b. IEEE Institute of Electrical and Electronics Engineers
 - c. NEMA National Electrical Manufacturers Association
 - d. UL Underwriters Laboratories, Inc.

D. Manufacturers

1. All VFD's for this project shall be as manufactured by Allen-Bradley\Rockwell Automation, ABB or Toshiba.

E. Enclosures

1. The unit must be capable of being mounted in a NEMA 2 vented enclosure.
2. The drive shall have power terminal blocks physically separate from the control signal terminal blocks.
3. Bypass VFD and all accessories shall be housed in a single manufacturer provided, stand alone enclosure.

F. Drive Environment

1. The ambient temperature range is 35° F to 100° F.
2. Unit shall operate satisfactorily at 3,300 feet above sea level without derating.
3. Unit shall operate satisfactorily in a range of 5 to 95 percent humidity.

G. Input Power

1. Variations of up to plus or minus 10 percent of the rated input voltage will be permitted without the drive shutting down on a fault.
2. Variations of up to plus or minus 2 Hz of the line frequency will be permitted
3. without the drive shutting down on a fault.
4. Power line interruptions of up to 0.5 second or greater will be permitted without the
5. drive shutting down on a fault.
6. The drive shall present a displacement power factor of 0.98 or better to the AC line
7. at any speed or load.
8. The drive shall not require an input isolation transformer. Input impedance at the
9. drive shall be no less than 3.0%.
10. The drive control efficiency at rated load and frequency shall be 97% or better.
11. The drive input circuitry shall not generate line notches or large voltage transients on the incoming line.

H. Output Power

1. The drive shall produce a three phase output for the load.
2. The output frequency of the drive shall be adjustable from 0 to 120 Hz in 0.01 Hz increments.
3. The drive shall have the ability to supply 180% of the rated starting torque of the motor.
4. The drive shall be capable of maintaining 100% of rated output current continuously when operating within the specified range of ambient conditions.
5. The drive shall be capable of delivering 115% of the motor rated current for up to one minute when operating within the specified range of ambient conditions.
6. The drive shall allow for the setting of the voltage to frequency relationship in the region below the Field Weakening Point.
7. The drive shall have a programmable pulse-width-modulated (PWM) carrier frequency.
8. The drive shall be capable of operating open circuited with no fault or damage.
9. The drive shall produce the rated voltage at 60 Hz and shall stay constant at that rated voltage for output frequencies greater than 60 Hz.
10. The drive output waveform shall be the PWM type waveform producing smooth torque at low frequencies and producing low amplitude harmonics.
11. The total harmonic voltage distortion shall be limited to 5%. Harmonic trap filters shall be furnished as required to control harmonic distortion to the required limits. Provide harmonic calculations and include in submittal for approval.

I. Control Features

1. The drive shall produce an output frequency proportional to the speed reference without external feedback.
2. The drive shall maintain set frequency and not require readjustment due to changes in load.
3. The drive shall have two independently adjustable acceleration and deceleration rates.
4. The drive shall have a current limiting circuit that decreases the acceleration rate of the motor should the load inertia causes excessive currents.

5. The drive shall have a selectable deceleration voltage limiting circuit which will extend the deceleration ramp should the bus voltage approach high limits due to regeneration.
 6. The drive shall have the option to block out five frequency ranges to minimize problems due to mechanical resonance in the driven equipment.
 7. The drive shall have a incrementally adjustable IR compensation boost to produce higher voltages at low speeds.
 8. The drive shall contain two analog inputs as standard which are both capable of operating from 0-10 VDC or 0-20 mA or a potentiometer.
 9. The drive shall produce analog output signals of 0 to 20 mA which can be proportional to output frequency, motor speed, output current, output voltage, motor torque, motor power, DC Bus voltage and motor voltage.
 10. The drive shall have the option to be programmed with DC Injection Breaking as part of the program stop function.
 11. The drive shall have an RS-485 port.
 12. The drive shall be able to communicate with the existing Siemens Controls system. Provide internal interface card.
 13. The customer interface shall include a 40 character digital display with keypad.
 14. Dedicated terminal blocks for hard wire Start/Stop, Fire, Freeze and Start interfaces by customer. All external interlocks and Start/Stop contacts shall function in Hand, Auto, or Bypass mode.
- J. Motor Protection
1. Motor protection shall conform to UL recognized M.O.L. (508C).
- K. Phase Protection
1. The drive shall have protection against a phase-to-phase short in the output load, or a short circuit in a phase of the output module.
- L. Drive Protection
1. The drive shall have:
 - a. Over current protection (375% instantaneous) with automatic restart.
 - b. Short circuit protection (phase to phase).

- c. DC bus under voltage protection (65%).
- d. DC bus over voltage protection (130%).
- e. Over temperature protection.
- f. Power semiconductor protection.
- g. Ground Fault protection.

M. Options

1. 5% Line Reactors
2. Soft Start Manual Bypass
3. Pre-wired Hand-Off- Auto Switch

L. Service

1. Startup service performed by a factory approved and certified technician.
2. To be included with the startup service, for a period of two years after initial startup, is a full parts and labor onsite warranty at no additional costs.
3. The service center must be permanently located within (100) miles of the job site.

O. Field tests and Checks

1. Testing, checkout and startup of the VFD equipment shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances are any portion of the drive system to be energized without authorization from the manufacturer's representative.
2. The VFD manufacturer shall provide to the owner a startup service for all VFD's provided. The service shall include inspection, final report for record purposes.
3. A copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the owner for this record.

3.0 EXECUTION

A. EXAMINATION

1. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
2. Proceed with installation only after all unsatisfactory conditions have been corrected.

B. INSTALLATION

- A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.3. CONNECTIONS

- A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
- B. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
- C. Duct installation and connection requirements are specified in Division 23 of this document.
- D. Electrical installation requirements are specified in Division 26 of this document.

3.4. FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.5. START-UP SERVICE

- A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.6. DEMONSTRATION AND TRAINING

- A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire Make-Up Air unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

1. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.
- C. FIELD QUALITY CONTROL
1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.
- D. START-UP SERVICE
1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.
- E. DEMONSTRATION AND TRAINING
1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire Make-Up Air unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

3.1 VFD INSTALLATION, ADJUSTING & DEMONSTRATING

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, province, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.
- D. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.

- E. Manufacturer's Field Service: Engage a factory authorized service representative to perform the following:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation.
 - 2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
 - 3. Report results in writing.
- F. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- G. Set field adjustable switches and circuit breaker trip ranges.
- H. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. A minimum of one (1) four hour training session shall be provided.

+ + END OF SECTION 237800 + +

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PART 1 - GENERAL**1.01 SUMMARY**

- A. The Building Automation System (BAS) work shall include the provision of all labor, materials, wiring, conduit, piping and mounting, control transformers, relays, tools, equipment, software, software licenses, software configurations and database entries, interfaces, labeling, calibration, submittals, testing, training services, transportation, shipping, handling, administration, supervision, insurance, temporary protection, and warranties which are required for the complete, fully functional and commissioned BAS.
- B. The BAS shall provide World-Wide Web-based Internet Explorer access to the control system as part of the standard installation. The user shall be able to access all displays of real-time data that are part of the BAS via a standard Web browser. The BAS shall tie into the network via Owner-supplied Ethernet network connection and be accessible from any Internet Explorer connection, with proper passwords. BAS network controller(s) shall be furnished and shall have the capacity to support a minimum of 30% more points and devices than are required for the BAS. Network controllers shall be Supervisory Controller (FX-80) with embedded BACnet IP server license and backup power source.
- C. The BAS contractor is responsible and shall coordinate with owner the integration into the campus existing automation system (Niagara AX).
- D. No special vendor-supplied software shall be needed on the various personal computers running the browser. All displays shall be viewable and shall directly access real-time data from the building's BAS network. Data shall be updated automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate password. Password protection shall be multi-level to accommodate different user groups.
- E. The BAS Contractor shall furnish to the project Mechanical Contractor all devices requiring duct or pipe mounting for installation by the Mechanical Contractor.
- F. Motorized dampers and control valves shall be provided by the control contractor, mounted by the Mechanical Contractor, wired and programmed by this contractor. Purchase of this material shall be coordinated with mechanical contractor so as not to delay installation.
- G. Graphics displays are required as part of the FX controller and visual displays of data shall be organized in a logical user-friendly manner and reference building where installed. Data shall include: sensor input variables, output signal variables, status, setpoints and alarms. All device names and tag numbers shall conform to the as-built drawings.
- H. BAS local distributed building controllers shall not be required to have spare capacity, unless specified otherwise, for all functions over what is required to satisfy the sequence of operations.
- I. All control devices shall be available for direct purchase by the Owner from multiple distributors.
- J. All programming shall be resident inside the local distributed controller, not in the network controller, except scheduling. All building controllers shall remain fully functional on loss of communications from the network controller.
- K. Sensor inputs shall **not** be shared among different equipment systems.

- L. Programming and labeling shall be in full accordance with the project contract control diagrams and sequences. The BAS Contractor shall make no deviations unless these are requested and approved in writing through the RFI process.
- M. The BAS Contractor shall participate in the final commissioning test with the Owner's designated commissioning agent. Based on the approved submittals, prior to start of commissioning work the BAS Contractor shall have calibrated and verified operation of all his work. If during the commissioning test it is found that more than 10 percent of the control system, including sequences, fails to meet requirements the procedure will be terminated. A new time and date for the commissioning to restart will be established. The commissioning agent will provide 1 test and 1 retest to confirm full operation of the control system. Beyond that, any time spent in commissioning (including time by the Owner's commissioning agents and engineer) shall be paid for by the BAS Contractor.
- N. A Johnson Controls qualified ASI – (Authorized Systems Integrator) will provide sole source responsibility for a complete, turnkey, and fully functional system of all new system components. The proposed BMS system shall be web-based, complete and seamlessly integrated. Each component will be of the same manufacturer and model number, as much as practicable, and shall be suitable for the application
- O. The scope of work consists of, but is not limited to, the following:
- I. The proposed project shall consist of the complete, systematic installation of a BMS system. The BMS contractor (BMSC) will furnish all labor, equipment, and materials necessary to complete a fully functional BMS system for the Owner as specified.
 - II. The BMSC will provide, but not be limited to, the following general sequence of tasks:
 1. Perform a field investigation of the existing network controllers associated with the project to obtain site-specific information required to prepare for bidding.
 2. Perform detailed design of the physical installation, component interconnection and wiring for all instrumentation and control system equipment and components.
 3. Prepare and submit for review submittals, including approval of graphical screens, alarms, and historical data storage and reports.
 4. Prepare and submit for review a detailed migration plan of transition from existing campus control systems to the new BMS system.
 5. Procure, assemble and test the associated control equipment.
 6. Provide installation and inter-connection of all control equipment.
 7. Configure graphical screens, alarms, and historical data storage and reports.
 8. Perform field-testing including startup.
 9. Provide system As- Built record documentation.
 10. Provide O & M Manual(s).
 11. Provide computer software back up of all BMS controllers.
 12. Provide required Owner training.
 13. Provide maintenance and warranty service within project warranty period.
- N. The BMS Subcontractor shall be responsible for all 120v power wiring required for any new or existing BMS control devices. This shall include connecting into the power panel and providing (if needed) new circuit breakers. All power wiring to be ran in conduit.

1.02 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. BAS: Building Automation System.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.
- H. Local Controller: A DDC FX field controller on the BAS network originating from the FX-80.
- I. FX-80: Network Automation Controller; The central BAS network controller connected to the Ethernet.

1.03 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
 - a. State of Rhode Island applicable electrical and mechanical codes and addendums
 - b. National Fire Protection Association (NFPA) Standards.
 - c. National Electric Code (NEC) and applicable local Electric Code.
 - d. Underwriters Laboratories (UL) listing and labels.
 - e. UL 916 Energy Management
 - f. NFPA 70 - National Electrical Code.
 - g. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 - h. Factory Mutual (FM).
 - i. American National Standards Institute (ANSI).
 - j. National Electric Manufacturer's Association (NEMA).
 - k. American Society of Mechanical Engineers (ASME).
 - l. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - m. Air Movement and Control Association (AMCA).
 - n. Institute of Electrical and Electronic Engineers (IEEE).
 - o. American Standard Code for Information Interchange (ASCII).
 - p. Electronics Industries Association (EIA).
 - q. Occupational Safety and Health Administration (OSHA).
 - r. American Society for Testing and Materials (ASTM).
 - s. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 - t. Americans Disability Act (ADA)
 - u. ANSI/EIA 909.1-A-1999 (LonWorks)
 - v. ANSI/ASHRAE Standard 135-2004 (BACnet)

- w. IEEE 802.15.4 ZigBee
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.04 SYSTEM PERFORMANCE

- A. The college shall provide numbering sequences for BACnet protocol.
- B. Controllers and sensors shall comply with the following performance requirements:
 - 1. Display: Display current data within 10 seconds.
 - 2. Refresh: Update current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm within 45 seconds.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 - 8. Reporting Accuracy: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
 - e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
 - f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
 - g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
 - h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 5 percent of reading.
 - 9. Stability and Quality of Control: Final control elements, such as valves and dampers shall not exhibit excessive swings and hunting action to obtain control of a setpoint variable. Also, any elements associated with heating or cooling shall not overlap their control functions.

1.05 BAS DESCRIPTION

- A. The Building Automation System (BAS) shall be a complete system designed for scalable implementation from small stand-alone use to large, networked systems. This functionality shall extend into the equipment rooms. Devices residing on the enterprise IT network shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
- B. All points of user interface shall be on either local display, standard PCs with appropriate software, a standard Web Browser or a combination of these methods.
- C. Where necessary and as dictated elsewhere in these Specifications, a Server will be used to providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data will be stored in a database. The server will be physically located in the Lincoln Middle School.
- D. The work of the single BAS (ASI) Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
- E. The BAS work will consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items; even though these may not be specifically mentioned in the bid documents which are required for the complete, fully functional and commissioned BAS.
- F. Provide a complete, neat and workman-like installation. Use only manufacturer-approved employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations for this Project.
- G. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades to not impede or delay their work.
- H. The BAS as provided shall incorporate, as required the following integrated features, functions and services:
 - a. Operator information, alarm management and control functions.
 - b. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - c. Diagnostic monitoring and reporting of BAS functions.
 - d. Offsite monitoring and management access.
 - e. Energy management.

- f. Standard applications for terminal HVAC systems.

1.06 SEQUENCE OF OPERATION

- A. Refer to drawings for control sequences. The BAS Contractor shall provide control sequences exactly as indicated on the contract documents. These sequences shall be submitted for Engineering Approval and Record as part of the submittal on 11 x 17 drawings.

1.07 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software and operator interface.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram and points list.
 - a. Point labeling shall be consistent with contract drawings and network display.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 2. Wiring Diagrams: Power, signal, and control wiring.
 4. Schedule of dampers including size, leakage, and flow characteristics.
 5. Schedule of valves including flow characteristics.
 6. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between control unit locations.
 7. Controlled Systems:
 - a. Points list.
 8. Sequence of Operation on 11x17.
 9. Flow Diagrams with all control devices shown and labeled on 11x17.
- Q. Field quality-control test reports. Furnish signed report attesting to successful completion of the quality control requirements specified herein, prior to commissioning.

R. Operation and Maintenance Data:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. As-built control wiring schematics at conclusion of project.
3. Supervisory controllers and field controller's backup shall be submitted as part of the O&M manuals.
4. All programming backup shall be submitted in disc format.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. Furnish equipment to Mechanical and Electrical Contractors for mounting, piping and wiring.

1.10 COORDINATION

- A. Coordinate location of thermostats, sensors, humidistats, and other exposed control sensors with plans and Mechanical and Electrical Contractors before installation.
- B. Coordinate sizes of control dampers with plans and Mechanical Contractor.
- C. Coordinate instrument piping requirements with plans and Mechanical Contractor.
- D. Coordinate supply of conditioned electrical branch circuits for control units with Electrical Contractor.
- E. Coordinate power and control requirements with Electrical Contractor.
- F. Controls contractor shall assist with the Testing, Adjusting and Balancing (TAB) contractor and Commissioning Agent (CA) as required by the selected contractors. Controls contractor shall carry an allowance of a minimum of 80 hours for assisting the selected TAB and CA contractors.

1.11 WARRANTY OF SYSTEM

- A. Provide controls supplier's warranty of performance of entire system as required by Contract documents. Performance and components requirements are established by control sequences and diagrams on Drawings and by this Paragraph.
- B. The Subcontractor shall guarantee the controls to be free from defects in material and workmanship and guarantee performance of systems as required by Contract Documents for one year of normal use and service beginning on date Owner begins to receive beneficial use of system and system has been accepted.
- C. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and the engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
- D. Control system failure during the warranty period shall be adjusted, repaired or replaced at no charge or reduction in service to the owner.

1.12 ACCEPTANCE TESTING

- A. At substantial completion of the work, this Subcontractor shall prepare a punch list of all items remaining to be completed or corrected. The failure to include any items on such list does not alter the responsibility of this Subcontractor to complete all work in accordance with the contract documents. This list shall be delivered to the Owner prior to Subcontractor's request for formal acceptance testing.
- B. Acceptance Test Procedure:
 - 1. This Subcontractor shall demonstrate in the presence of the Owner that all functions of the control systems are operating as specified in the contract documents, including any required change orders. The final checkout will include, but not be limited to, the following items:
 - a. Provide hard copy of fully annotated program (PPLC) with comment lines for review and approval.
 - b. Verification of the location, calibration and proper wiring/connection of all input and output devices.
 - c. The proper operation and calibration of all ATC devices and actuators shall be verified individually.
 - d. When system performance is deemed satisfactory, system parts shall be accepted for beneficial use. Warranty shall begin. All minor deficiencies found will be noted in writing by the Owner. This Subcontractor shall correct all deficiencies so noted before the final acceptance will be issued.

- e. System Acceptance and start of warranty is contingent upon:
 - 1. Controls submittal approved by the Engineer
 - 2. Review of system graphics by the Engineer
 - 3. Proof that the system is operating per the contract documents
 - 4. System is commissioned and signed -off by Engineer/Owner

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 APPROVED CONTROL SYSTEM

- A. Facility Explorer by Johnson Controls.

2.03 BAS ARCHITECTURE

- A. Automation Network
 - a. The automation network shall be configured as a Client/Server network with a web server operating on the Client's LAN/WAN. The web browser interface is extended over the LAN/WAN. Monitoring and control of the BAS is available using the web browser interface.
 - b. The automation network shall include the option of a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
 - c. The BAS shall network multiple user interface clients, system controllers and systems supervisors as required for systems operation.
 - d. The automation network option shall be capable of operating at a communication speed of 100 Mbps.
 - e. Supervisory Controllers shall reside on the Automation Network
 - f. The automation network option will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- B. Control Network
 - a. Supervisory Controllers shall provide management over the control network(s) and shall support the following communications protocols:
 - 1. BACnet® Standard (ANSI/ASHRAE Standard 135-) MS/TP and Ethernet/IP
 - 2. LONWORKS® enabled devices using the free topology transceiver (FTT-1x).

3. Johnson Controls® N2 Open.
 4. Modbus RTU and Modbus TCP.
 - b. The Supervisory Controller shall be BTL (BACnet Testing Laboratories) listed as B-BC (BACnet Building Controller) and support the following data link options:
 1. BACnet Internet Protocol (IP) (Annex J).
 2. BACnet IP (Annex J) Foreign.
 3. ISO 8802-3, Ethernet (Clause 7).
 - c. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
 - d. Programmable Controllers shall reside on the control network.
 - e. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
 - f. The PICS shall be submitted 10 days prior to bidding.
- C. Integration
- a. Hardwired
 1. Analog and digital signal values will be passed from one system to another via hardwired connections.
 2. There will be one separate physical point on each system for each point to be integrated between the systems.
 - b. Direct Protocol (Integrator Panel)
 1. The BAS shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS system and 3rd party manufacturers’ control panels. The BAS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, lighting and medical gas.
 2. All data required by the application will be mapped into the BAS, and shall be transparent to the operator.
 3. Point inputs and outputs from the third party controllers shall have real time interoperability with BAS software features such as: Schedules, Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
 - c. BACnet Protocol Integration
 1. The BACnet over Ethernet and BACnet MS/TP shall comply with the ASHRAE BACnet standard 135-2004.
 2. Provide a complete Protocol Implementation Conformance Statement (PICS) for all BACnet system devices.
 3. Provide the ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems.
 - d. Modbus Protocol Integration
 1. The BAS shall provide direct connection to Modbus devices without the use of protocol converters.
 2. Map all data required by the application into the BAS and shall be transparent to the operator.
 3. Point inputs and outputs from the Modbus devices shall have real-time interoperability with BAS software features such as: Schedules, Control Software, Energy Management, Custom Process programming, Alarm Man-

agement, Historical Data and Trend Analysis, Totalization and local area network communications.

2.04 USER INTERFACE

- A. Browser Based Operator Interface
- a. The system shall be capable of supporting an unlimited number of clients using standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
 - b. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the Building Automation System (BAS), shall not be acceptable.
 - c. The Web browser client shall support at a minimum, the following functions:
 1. User log-on identification and password shall be required. Display unauthorized user attempts access, notice of access failure. Implement security using authentication and encryption techniques to prevent unauthorized access.
 2. HTML programming is not required to display system graphics or data on a Web page. Allow for editing of the Web page if the user desires a specific look or format.
 3. Storage of the graphical screens shall be in the Supervisory Controller or the server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 4. Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.
 5. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - i. Modify common application objects, such as schedules and setpoints in a graphical manner.
 - ii. Commands binary objects to start and stop.
 - iii. View logs and charts.
 - iv. View alarms.
 - v. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
 - d. Alarms
 1. Alarm feature shall allow user configuration of criteria to create, route, and manage alarms and events. At the request of the School Department, implement specific alarms from specific points routed to specific alarm recipients. The alarm management portion of the user interface provide the following functions:
 - i. Allow configuration to generate alarms on any numeric, binary, or data point in the system.
 - ii. Generate alarm records that contain a minimum of a timestamp, original state, acknowledged state, alarm class and priority.
 - iii. Allow the establishment of alarm classes that provide the routing of alarms with similar characteristics to common recipients.

- iv. Allow a user, with the appropriate security level, to manage alarms - including sorting, acknowledging, and tagging alarms.
- e. Reports and Summaries
 1. Generate reports and summaries and direct to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - i. All points in the BAS
 - ii. All points in each BAS application
 - iii. All points in a specific controller
 - iv. All points in a user-defined group of points
 - v. All points currently in alarm
 - vi. All BAS schedules
 - vii. All user defined and adjustable variables, schedules, interlocks and the like
 2. Reports shall be exportable to .pdf, .txt, or .csv formats.
 3. The system shall allow for the creation of custom reports and queries.
- f. Schedules
 1. Provide a graphical display for time-of-day scheduling and override scheduling of building operations. At a minimum, the following functions will be provided:
 - i. Regular schedules
 - ii. Repeating schedules
 - iii. Exception Schedules
 2. Provide weekly schedules for each group of equipment with a specific time use schedule.
 3. It shall be possible to define one or more exception schedules for each schedule including references to calendars.
 4. Provide monthly calendars that allow for simplified scheduling of holidays and special days. Holidays and special days shall be user-selected with the pointing device or keyboard.
- g. Password
 1. Multiple-level password access protection shall be provided to allow the system manager to assign user interface control, display, and database manipulation capabilities deemed appropriate for each user based on an assigned password.
 2. Each user shall have the following: a user name, a password, and access levels.
 3. The system shall provide the capability to require a password of minimum length and require a combination of characters and numerical or special characters.
 4. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
 5. The system shall provide unlimited flexibility with access rights. Provide a minimum of four levels of access along with the ability to customize the system to provide additional levels.
 6. Support up to a minimum of 100 unique passwords.
 7. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
 8. The system shall automatically generate a report of log-on/log-off and system activity for each user.
 9. All log data shall be available in .pdf, .txt, and .csv formats.

- h. Dynamic Color Graphics
 - 1. Supply the graphics application program as an integral part of the User Interface.
 - 2. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
 - 3. The graphics shall be able to display real-time data that is acquired, derived, or entered.
 - 4. Graphics runtime functions –Each graphic application shall be capable of the following functions:
 - i. All graphics shall be fully scalable
 - ii. The graphics shall support a maintained aspect ratio.
 - iii. Multiple fonts shall be supported.
 - iv. Unique background shall be assignable on a per graphic basis.
 - 5. Operation from graphics – It shall be possible to change values (setpoints) and states in systems controlled equipment within the Web browser interface.
 - 6. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all runtime binding.
 - i. Historical Data Collection
 - 1. All numeric, binary or data points in the system database shall allow their values to be logged over time (trend log). Each historical record shall include the point's name, a time stamp including time zone, and the point's value.
 - 2. The Supervisory Controller shall have the ability to store its historical data records locally and periodically to a remote server on the network (archiving).
 - 3. The configuration of the historical data collection shall allow for recording data based on change of value or on a user-defined time interval.
 - 4. The configuration of the historical data collection shall allow for the collection process to stop or rollover when capacity has been reached.
 - 5. A historical data viewing utility shall be provided with access to all history records. This utility shall allow historical data to be viewed in a table or chart format.
 - 6. The history data table view shall allow the user to hide/show columns and to filter data based on time and date. The history data table shall allow exporting to .txt, .csv, or .pdf file formats.
 - 7. The historical data chart view shall allow different point histories to be displayed simultaneously, and also provide panning and zooming capabilities.
 - j. Audit Log
 - 1. For each log entry, provide the following data;
 - i. Time and date
 - ii. User ID
 - iii. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
 - k. Database Backup and Storage
 - 1. a. The user shall have the ability to backup the Supervisory Controller databases.
- B. Portable Operator Terminal

- a. The BAS (ASI) Contractor shall provide a portable operator terminal for programming purposes. The terminal shall be configured as follows:
 1. Personal Laptop Computer
 2. 4 GB RAM (minimum) – Windows 10, Windows 8.1, Windows 7.
 3. SVGA 1024x768 resolution color display
 4. Complete workstation software packages, including any hardware or software.
 5. Software registration cards for all included software shall be provided to the Owner.
 6. External power supply/battery charger
- b. Software
 1. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
 2. When used to access First or Second Tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
 3. When used to access Application Specific Controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.

2.05 DDC EQUIPMENT

- B. All on/off point types shall be of binary values as accepted by BACnet protocol.
- C. Control Units: Modular FX field controllers, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel inside enclosure and integral interface equipment.
 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator display; and download from or upload to operator display.
 2. Control units for major equipment, such as air handlers, pumps, makeup air units, VAV terminal units, etc. shall be mounted within enclosures and appear as a digital controller with display.
 3. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 4. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.

- c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Remote communications.
 - e. Maintenance management.
 - f. Units of Measure: Inch-pound and SI (metric).
5. Local operator interface provides for download from or upload to operator display.
 6. VAV terminal unit controller shall be FX-VMA's.
- D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source excluding VAV terminal units.
1. Units monitor or control each I/O point, process information, and download from or upload to operator display.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator display.
- E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. Response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

- G. Power Line Filtering: Internal or external transient voltage and surge suppression for controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.
- H. APPROVED COMMUNICATION PROTOCOL
- A. BACnet Communication Protocol

2.06 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. RTDs and Transmitters:
1. Accuracy: Plus or minus 0.2 percent at calibration point.
 2. Wire: Twisted, shielded-pair cable.
 3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 4. Averaging Elements in Ducts: 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
 6. Sensor-only: Blank faceplate for areas designated on plans.
 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- C. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 3 percent full range with linear output.
 2. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 3. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F (minus 30 to plus 85 deg C).
 4. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- D. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 0.25 percent of full scale.
 - b. Output: 4 to 20 mA or 0-10 VdC
 - c. Static-Pressure Range: 150% of maximum operating pressure.
 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service.

3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.07 STATUS SENSORS

- E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

2.08 THERMOSTATS

- F. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 2. Selector Switch: Integral, manual on-off-auto.
- G. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet (6 m).
 2. Quantity: One thermostat for every 20-sq. ft. (2 sq. m) of coil surface.
- H. Electric, High-Limit Duct Thermostat: Snap-acting, manual-reset switch that trips if temperature sensed is equal to or above set point (125°).
1. Manufacturer: White-Rogers model 5C06-125.
- I. Electric; Changeover Thermostat:
1. For 1/2" tubing or less: Sealed bi-metallic disc, SPDT snap-action contacts, strap-on connection. Manufacturer: White-Rogers model 752.
 2. For piping, greater than 1/2": Remote bulb, SPDT switch, 20 to 120°F range, 5 to 30° adjustable differential. Manufacturer: White-Rogers model 2A38-14.

2.09 ACTUATORS (BELIMO)

- J. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:

- a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. (49.6 kg-cm/sq. m) of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 6. Power Requirements (Two-Position Spring Return): 24-V ac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C) if outdoors; 40 to 104 deg F (5 to 40 deg C) indoors.
 10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).

2.10 CONTROL VALVES (BELIMO)

- A. Control Valves: Furnished by the Control Contractor delivered to the Mechanical Contractor for installation. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system ball valves shall have the following characteristics:
 1. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 2. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 70 psi of pressure differential across valve.
 3. Temperature Characteristics: Maximum service temperature rating for hydronic valves shall be 230°F.
 4. See the Mechanical Sequence of Operation and Control Schematics along with Mechanical Schedules and Details for control valve type, model numbers and sizes.

2.11 DAMPERS

- A. Dampers: Furnish AMCA-rated; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
 1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
- B. Smoke Dampers: Furnish UL 555S rated, galvanized steel smoke damper with electric actuator and end switch. Coordinate damper size and actuator mounting location with General and Mechanical Contractors.

2.12 FLOW METERS

- A. Air Flow Measurement Stations: Furnish air flow sensor and transmitter for locations shown. The flow sensor shall operate based on "Thermal Dispersion" technology. Quantity and placement of sensors shall be in accordance with manufacturer's published recommendations for the installed airflow accuracy listed. Transmitter output shall be compatible with DDC system. Manufacturer: Ebtron, series GTx116-P.

2.13 TOXIC GAS MONITOR

- A. General - The monitoring system shall draw, via an internal pump, gas samples to the internal analyzer(s) from up to 32 locations and sequentially measure the gas concentration. The system shall provide visual alarm indication when preset levels are exceeded. Relay outputs for the purpose of external alarm or control shall be provided. Gas concentrations and alarm settings can be exported to a flash drive into a .CSV format. The Gas to be detected shall be Methane NH₄ (Natural Gas), Carbon Monoxide (CO), Nitrogen Dioxide (NO₂) – 19 points of sampling will be required, see drawings for locations. Monitoring panel shall have the ability to sample (4) types of gases.
- B. Measured Gas - The system shall measure (Gas(es)) in the concentration range of zero to (value) full scale.
- C. System Configuration - The system shall consist of the following three sub-systems:
- 1 - System Controller
 - 2 - Gas Sample Handler
 - 3 - up to four Analytical or Sensors
- D. All sub-systems shall be mounted in a single enclosure. Any of the analytical sub-systems, however, may be optionally located separately.
- E. Enclosure Type - The system enclosure shall be rated as NEMA 1 and shall conform to Paragraphs 1 thru 7.
1. Access Door - A full length front access door shall be provided.
 2. Electrical Entry - A gasketed, removable plates shall be provided in the enclosure bottom for purposes of providing electrical entry.
 3. Sample Tubing Connection - NPT fittings suitable for the connection of 1/4" OD, 3/16" inch ID tubing shall be provided on the sides of the enclosure for the purposes of connection, sample lines, calibration gases and exhaust.

4. Indicators - An impact resistant 10" diagonally measured color TFT touchscreen Display for gas sample systems shall be provided on the access door of the enclosure for the purpose of viewing all operational parameters of the unit.
 5. Mounting - Brackets suitable for wall mounting shall be provided.
 6. Size - No dimension (Height, Width, Depth) shall exceed 1.5 meters (4.5 feet).
 7. Controls - There shall be no switches, levers or buttons on the front cover of the unit. The operator interface to the unit shall be via the soft buttons on the front panel display. These soft buttons are activated by touching the front panel display screen.
- F. Controller - The controller sub-system shall conform to the following paragraphs:
1. Type - The controller shall be an Allen-Bradley (AB) CompactLogix Logic Controller.
 2. Programmable Functions - All programmable functions will be entered via the soft keys on the front panel touch screen. The following functions shall be programmable:
 - a. Sequencing point order
 - b. Manual calibration sequence
 - c. Automatic standardization, sequence and associated timing parameters and adjustment limits
 - d. Parameters for the common alarm relays:
 1. latching or non-latching alarm function
 2. upscale or down scale acting alarms
 3. fail safe or non-fail safe relay operation
 4. On delay relay operation
 5. Off delay relay operation
 - e. Removal or skipping of any location from the sampling sequence
 - f. Setting Trouble, Warning and Alarm trip point levels per sampling point per analyzer or sensor
 - g. Changing the password
 - h. Setting the gas sample transport time per sampling point
 - i. Setting the analysis time
 - j. Enabling the extended analysis time with the following trigger threshold parameters:
 1. Rate of signal rise per analyzer or sensor
 2. Signal level increasing to a preset level
 3. Signal level decreasing to a preset level
 - k. Setting the alarming hysteresis per analyzer or sensor
 - l. Parameters for the optional user configured output relays:
 1. fail safe or non-fail safe relay operation
 2. On delay relay operation
 3. Off delay relay operation
 4. Steady or pulsed outputs
- G. Programming Lock Out - A password shall be necessary for the purpose of preventing

unauthorized personnel from altering the systems programmed parameters.

- H. System Memory - All programmed values shall be stored on a Secure Digital (SD) Card that is local to the processor. Battery backup shall be provided to retain current status if power is lost.
- I. Alarm/Control - Four common alarm/control set point levels shall be provided for all sample location. These four will be: Horn, Trouble, Warning and Alarm. These relays will be single pole double throw (SPDT) at least 8 amp @ 250 VAC. The system shall have the capability of providing up to 64 optional user configurable discrete alarm relays or solid state outputs.
1. Optional user configurable discrete alarm relays
 - a. These optional discrete alarm relays shall be single pole double throw (SPDT) at least 10 amp @ 250 VAC.
 - b. These optional discrete alarm relays shall be available in the following configuration:
 - 16 warning & 16 alarm relays
 - 32 warning & 32 alarm relays
 2. Optional user configurable solid state outputs
 - a. These optional solid state outputs shall be capable of sinking 100 mA @ 24 VDC.
 - b. These optional solid state outputs shall be available in the following configuration:
 - 16 warning & 16 alarm outputs
 - 32 warning & 32 alarm outputs
 3. Front panel display- The front panel display shall be provided for the purpose stated in the following paragraphs
 - a. Alarm Indication
 - b. Location Indicator
 - c. Malfunction Indicator - The display shall be indicate any of the following conditions:
 - a. analyzer under range
 - b. analyzer over range
 - c. auto standardization limit exceeded
 - d. flow failure
 - d. Sequence Mode Indication
 - e. Calibration Mode Indication
 4. Automatic Analyzer Correction - The controller must be capable of introducing zero and calibration gases and automatically correcting the gas value reading. Timing and limits setting shall be programmable according to Paragraph F.
 5. Data Storage – Gas concentrations and alarm setting shall be capable of being exported to a flash drive in .CSV format via a removable SD Card.

6. Digital Output –BACnet IP output shall be available to enable communication to other equipment or controllers.
- J. Sample Handling - The sample handling sub-system shall conform to the following Paragraphs:
1. Sample Line Compatibility - The system shall be capable of drawing a gas sample through 3/16" ID NPT tubing for a distance of 166.6 meters (500 feet).
 2. Sample Line Flow Rate - The system shall be capable of drawing a gas sample through 0.175" ID tubing at a rate of at least 20 SCFH (10 LPM) typical, no load. The full load rate shall be: 10 SCFH (5 LPM) typical.
 3. Gas sampling scheme - The system shall employ a look ahead bypass sampling scheme. The system will not only pump on the current sampling point but also pump on the next sampling point even if the sampling point order is not in numeric order.
 4. Sample Conditioning - The system shall provide adequate filtration of the sample suitable to protect the analyzer.
 5. Exhaust - Exhaust fitting shall be provided on the side of the enclosure for the purpose of attaching exhaust lines to the sample and bypass flows.
 6. Calibration Gas Connection - Inlet fittings shall be provided on the side of the enclosure for the purpose of connecting the calibration gas supplies (zero and span).
 7. Flow Failure Detection - The system shall be capable of detecting a flow failure in any of the sampling lines.
- H. Analyzer - The analyzer(s) sub-system shall operate on the (specify) principle.
- I. System Performance - The system shall meet the requirements of the following paragraphs
- 1 Analyzer Reproducibility requirement - The analyzer(s) must keep its output signal reproducible within the limits of +2% Full Scale (FS).
 - 2 Analyzer Stability requirement - The 24 hour zero or span drift of the analyzer(s) must be less than 2% without the aid of automatic or manual recalibration.
 - 3 Environmental Specifications
 - a. Temperature - The system shall operate over the range:
Operating: 32° to 95°F (0° to 35°C)
Non-Operating: 14° to 140°F (-10° to 60°C)
Gas Sample: 0° to 140°F (-17° to 60°C)
 - b. Humidity- The system shall operate over the range:
5 to 85% RH non-condensing
- L. Programming Limits - The system parameters shall be capable of being adjusted within the

following limits:

1. Gas Sample Point Dwell Time = 10-300 seconds (in one second increments) per point.
2. Alarm Levels = 0-100% of full scale in one percent increments
3. Frequency of Automatic Zero = Every 8 hours
4. Frequency of Automatic Span = Every 8 hours
5. Automatic Adjustment Limits = "5% (before trouble is indicated)

M. Power Requirement - The system shall need the following electrical power to operate:

- 5 Amp. @ 115 VAC, 60 Hz, Single Sequencer Systems
- 10 Amp. @ 115 VAC, 60 Hz, Dual Sequencer Systems

N. Max System Maintenance Requirement - With the exception of resupply of zero and span gas, no routine maintenance shall be required.

O. Manufacturer Capability Requirements - As a minimum, the system manufacturer must meet the following requirements:

- a. be capable of supplying all equipment used to calibrate the system
- b. be capable of providing on-site service with factory trained personnel
- c. be capable of providing start-up assistance and training

P. Gas Monitoring System shall be a MSA MultiGard 5000 Gas Sampling System or equal.

Q. Include the cost of 16 hrs. (2 days) for a factory direct MSA field technician to calibrate and commission the system. Work shall include verification BACnet outputs, fan on/off, doors open, etc.. to ensure the system is fully operational before the system is turned over to the owner.

R. Provide and additional (4) hrs. of formal training for the MSA certified field technician to train RIPTA personnel on the use of the system.

S. Provide (1) year of maintenance contract and calibration for the system by either MSA direct or local MSA rep.

PART 3 - EXECUTION

3.01 PREPARATION

A. Furnish all control valves to Mechanical Contractor for installation.

3.02 INSTALLATION

A. All control wiring, located in exposed areas (except above ceilings) shall be mounted in conduit. All control wiring located in RTU's and AHU's shall be mounted in conduit.

B. All control wiring, located above ceiling shall be installed in a neat workmanlike manor, bundled and tie wrapped neatly and not lying on the ceiling grid.

- C. Install software in control units and Web interface. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- D. Configure equipment and software to achieve sequence of operation specified.
- E. Coordinate location of flowmeters, thermostats, humidistats, and other exposed control sensors with other contractors, drawings and room details before installation.
- F. Install VAV box controller/actuator.

3.03 CONTROL ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. By this contractor.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing.
- B. Perform the following field tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 5. Test each system for compliance with sequence of operation.
 - 6. Test software and hardware interlocks.
 - 7. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 8. Check instruments for proper location and accessibility.
 - 9. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 10. Check pressure instruments, piping slope and installation of valve manifold.
 - 11. Check temperature instruments and material and length of sensing elements.
 - 12. Check control valves. Verify that they are in correct direction.
 - 13. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that DDC controllers are protected from power supply surges.
- C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.05 ADJUSTING

- A. Calibrating and Adjusting:
1. Calibrate equipment using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 2. Instrumentation used to calibrate flow measuring devices shall have current calibration records. Submit copies of these calibration records.
 3. Stroke and adjust control valves and dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 4. Provide diagnostic and test instruments for calibration and adjustment of system. All such equipment shall have current calibration certification.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls for a total of one eight-hour days of training.

3.07 TRAINING

- A. Provide a minimum of 24 hours total of owner training, throughout the contract period for personnel designated by the Owner.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Set field adjustable switches and circuit breaker trip ranges.
- D. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. A minimum of one (1) eight hour training session shall be provided.

3.08 VENDOR SYSTEM TESTING

- A. Testing
1. Assemblies and subassemblies shall be factory tested in accordance with BMS subcontractor standard quality assurance program. This testing shall be done prior to site acceptance tests.
- B. Site Acceptance Test
1. After the system is delivered and installed at the site, the system shall go through site acceptance test (SAT).
 2. Site Acceptance Test (SAT): Following installation of the BMS system, all hardware shall be aligned and adjusted, and all test readings recorded in accordance with the BMS subcontractors recommended tests and maintenance procedures. The BMS subcontractor shall include, in the associated test report, a list of all hardware components replaced or changed between the tests. All hardware shall be demonstrated to be operational by running the off-line diagnostics. The SAT test shall be considered complete only after all variances generated during installation are resolved and tested. The BMS Contractor shall utilize their standard SAT procedures.
 - a. All application software will be verified and compared against the sequence of operation. Control loops will be exercised by inducing a set point shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the test results sheet.
 - b. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a test Results sheet to the owner.
 3. Operational Acceptance Test: The BMS Contractor shall utilize their standard operational test procedures. After all previous testing has been successfully completed; operate the BMS, for fourteen (14) days. Any failure between field-sensing equipment and the control panels (included FEP's) shall be corrected, and the testing shall continue from the day of failure.
 - a. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance, and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the Owner.
 - b. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that all alarms have been configured, and that any associated graphics and

reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

4. Final Acceptance: The BMS will not be considered accepted by the Owner until all of the foregoing tests are successfully completed. Beneficial use of the system by Owner will not be considered as acceptance.
 5. Final Acceptance Criteria: Owner will deem the BMS to be fully accepted when:
 - a. All structured, unstructured and availability tests have been successfully completed, and all incidents and variances have been resolved.
 - b. All instrument calibration is current and is acceptable to Arden and the Owners Representative.
 - c. All documentation and training requirements have been completed and are satisfactory to the owner.
 - d. All identified defects have been corrected to the Owner's satisfaction.
 - e. Owner has received all required software licenses.
 - f. Operational check verification forms (each control loop).
 - g. Operation checks completion report (each system).
 - h. Graphic trend printout of all points indicated on the contract documents proving that the system is operating per the design intent for both the winter and summer seasons.
- C. Point to Point Checkout.
1. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by Arden for submission to the Owner or Owners Representative.
- D. Test and Calibration Procedures
1. Procedures to be generated by BMS Contractor utilizing their standard test procedures. All executed documents to be provided to owner upon completion.
 2. Control Panel Field Check
 - a. Verify power wiring, record breaker panel information, check for correct vol ages (primary and secondary). Visually check panel for damaged or loose components.
 3. Controller Procedure

- a. Check installation
 - b. Power-up controller
 - c. Enable battery backup
 - d. Write controller serial number on respective checkout sheet or affix serial number sticker to sheet and mark number on building plans at VAV, FCU etc. locations (by electrical sub-contractor)
4. Device Calibration
- a. Electric Actuators: Check and adjust all linkage and setup petitioners to require ranges. All valves and dampers shall be stroked through their ranges by disabling and manipulating outputs from the computer terminal while viewing end device. Modulating devices shall be tested at beginning, midpoint and end range.
 - b. Equipment start/stop. (Digital Output):
 - Ensure that proper equipment relays actuate via local override switches.
 - c. Equipment status/ current switches, auxiliary contacts. (Digital Inputs):
 - Ensure that correct input status is received upon operation of equipment.
 - d. Equipment Status/current transformers (Analog Input):
 - Ensure amperage draw readings are accurate. Compare reading with Amp meter.

3.09 SENSOR CALIBRATION

- A. The purpose of calibrating instruments prior to the start-up of a plant is to check the operability and calibration of the instruments by the simulation of operating conditions. After calibration, instruments shall be handled as little as possible.
- B. The Contractor shall provide 3-point calibration factory records for all calibrated instruments for qualified instrumentation.
- C. The Contractor shall perform signal transmission checks for all input points and corrective action to be performed to any analog sensor that falls outside the expected value at the zero and span adjustments for all analog sensors. All analog sensors shall receive single point verification with a certified instrument after installation. The single point verification shall be taken at midpoint of normal operating range. A 3-point calibration shall specify accuracy.
- D. The Contractor shall provide all factory and field Instrument Calibration Records performed and instrument Test Records filled out signed and submitted to the Owner for distribution and permanent records.

- E. The Contractor shall review Owner's calibration policy and notify Owner of any deviations from these requirements.

3.10 TEST INSTRUMENT AND CALIBRATION DOCUMENTATION

A. Test Instruments:

1. All calibration and test equipment used shall be traceable to the National Institute of Standards and Technology. Reference equipment used shall be a minimum of 4 times more accurate than the instruments being calibrated. Exception: 2 times for humidity.

B. Documentation:

1. The manufacturer shall provide current calibration certificates of all reference and test instruments used to perform field-testing prior to start of work.
2. All testing shall be documented by the manufacturer's technician.
3. Provide contractors loop checkout report and calibration forms for Owner's approval.

3.11 TESTING, INSPECTION, AND COMMISSIONING CRITERIA

- A. All materials, hardware, software/firmware, and documentation to be furnished under this specification shall be subject to observation and tests. Equipment shall not be accepted until all required observations, tests and third party commissioning has been made, demonstrating that the equipment conforms to the specification, and the hardware, software/firmware, and documentation, have been provided. Approval of inspections and test results, acceptance of hardware, software/firmware, and documentation or the waiving of observations and tests thereof shall in no way relieve the BMS subcontractor of the responsibility of providing equipment, software/firmware, and documentation which meets the requirements of this specification.
- B. The ATC Subcontractor shall provide time to assist the commissioning agent as needed along with demonstrating and providing all documentation required by the commission agent. Refer to Specification "HVAC Commissioning" for additional details.

3.12 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Subcontractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.
- B. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BMS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the Owner indicating that the installed system functions in accordance with the plans and specifications.

- C. The BMS subcontractor shall commission and set in operating condition all major equipment and systems, such as the computer room units and exhaust fans, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner.

+++ END OF SECTION 23 95 00+++

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1.0 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this Section consists of all labor and materials to fully adjust and balance air and water systems as shown on the attached drawings and as described in this Specification.
- B. This subcontractor shall coordinate and work closely with the ATC subcontractor, sheet metal subcontractor, piping subcontractor and Engineer to achieve required air and water balance.
- C. This contractor shall become familiar with all HVAC systems that are a part of this work.
- D. This contractor shall provide all instrumentation, fully calibrated, to undertake measurements as outlined in this specification.
- E. This contractor shall provide an air and water balancing report for each phase of work as described in this specification.
- F. The following systems shall be balanced:
 - 1. All RTU, ACU and EF fans scheduled and indicated on the contract documents.
 - 2. Pre-measurement via duct traverse of all existing RTU, ACU ad EF systems before they are demoed. Provide report to Engineer for review.
 - 3. Final measurement via duct traverse of all existing RTU, ACU ad EF systems before they are demoed. Provide report to Engineer for review and approval.
- G. Field support & paperwork & paperwork as needed to support the project commissioning.
- H. Balancer to include time spent in the field with the Engineer of Record as needed to prove readings indicated in report.

1.2 WORK NOT INCLUDED

- A. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, bring to the attention of the Mechanical Contractor for materials and installation requirements.
- B. Requirements and procedures for piping and ductwork systems leakage tests.

1.3 DEFINITIONS

- A. Systems testing, adjusting and balancing is the process of checking and adjusting airflow and fluid flow to produce the design objectives. It includes:
 - 1. Adjustment of total system to provide design quantities.
 - 2. Verification of performance of all equipment and automatic controls.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate at the equipment (e.g., throttling).
- D. Balance: To proportion flows within the distribution system (submains and branches) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for future required testing, adjusting, and balancing.
- G. Main: Pipe or Duct containing the system's major or entire fluid flow.
- H. Submain: Pipe or Duct containing part of the systems' capacity and serving two or more branch mains.
- I. Branch: Pipe or Duct serving a single point of use.

1.4 SUBMITTALS

- A. Procedures and Agenda:
 - 1. Submit a synopsis of the adjusting and balancing procedures and agenda proposed to be used for this project.
- B. Certified Reports:
 - 1. Submit adjusting and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

- a. Final Report: Upon verification and approval of draft reports, prepare final reports, typewritten, and organized and formatted as specified below. Submit four (4) complete sets of final reports.
- b. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be adjusted and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - General Information, Summary and Recommendations
 - New Air Cooled Chiller
 - Chilled Water Pumps
- C. Report Contents: Provide the following minimum information, forms and data:
 1. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
 2. The remainder of the report shall contain the appropriate forms containing, as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- D. Calibration Reports:
 1. Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Agency Qualifications:
 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

2. An independent testing, adjusting and balancing agency certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, certified by AABC as a Test and Balance Engineer.
 3. An independent testing, adjusting and balancing agency certified by National Environmental Balancing Bureau (NEBB) in these testing and balancing disciplines required for this project, certified by NEBB as a Test and Balance Engineer.
- B. Codes and Standards:
1. AABC: "National Standards for Total System Balance."
 2. ASHRAE: ASHRAE Handbook 2003, HVAC Applications, Chapter 34 Testing, Adjusting, and Balancing.
 3. SMACNA: Testing, Balancing and Adjusting of Environmental Systems.
 4. NEBB: National Environmental Balancing Bureau.
- C. Pre-balancing Conference:
1. Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.

1.6 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under their provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting and balancing Agent fails to comply with the Contract Documents.
- C. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions.
1. The certified Agent has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

- D. The balancing contract cannot be fulfilled until the balancing report is approved by the engineer of record. Any re-balancing work required due to a report being disapproved will be at the expense of the balancing contractor.
- E. Any additional field time requested by the Engineer to verify a balancing report reading in the field shall be provided at no additional cost to the owner.

1.7 HVAC EQUIPMENT LIST

- A. All proposed new equipment shall be verified with actual approved shop drawings or in the field.

2.0 PRODUCTS

2.1 ACCEPTABLE SUBCONTRACTORS

- A. Precision Air Balancing
- B. Environmental Testing and Balancing
- C. Thomas Young and Associates

3.0 EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting and commissioning specified in individual Specification Sections have been performed.
- D. Examine system and equipment test reports.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports and manual volume dampers are properly installed, and their

locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine air system to ensure clean filters have been installed, bearing are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Perform testing and balancing procedures on each system according to the procedures contained in the current edition of the NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems and this section.

3.2 AIR SYSTEMS

- A. Systems shall be adjusted and balanced so that air quantities and temperatures at outlets are as directed and so that the distribution from supply outlets is free from drafts and uniform over the face of each outlet.
- B. Adjustments shall be in such a manner that splitter and volume adjusters close to air outlets will have the least pressure drop consistent with volume requirements.
- C. Primary balancing shall be obtained by adjustment of the dampers at branch duct take-offs. Adjustable fan drives shall be used for making final adjustments of total air quantities. Additional dampers or other air volume adjusters required to accomplish the balancing and adjusting shall be furnished and installed as part of the HVAC work.
- D. Settings of dampers, splitters, and other volume adjusting devices shall be permanently marked, after completion of balancing and adjusting, so that they can be restored if disturbed at any time. Also, the addition and setting of baffles shall be included where required to get a good mix by the HVAC Subcontractor at the direction of the balancing and adjusting Subcontractor.
- E. Direct reading velocity meters may be used for comparative adjustment of individual outlets, but air quantities in ducts having velocities of 1,000 feet per minute or greater, shall be measured by means of traverses.
- F. Testing and balancing of systems which contain filters shall simulate the loaded (dirty) filter condition. Testing and balancing contractor shall artificially impose a pressure drop across the filters to accomplish this requirement. All fan speeds, damper settings and documentation shall be based on the dirty filter condition.

- G. Requires Tests and Balances – Air Systems: The following tests, balance procedures, and required adjustments shall be performed:
1. Initial Test and Balance:
 - a. Test and adjust all primary and secondary air quantities on the air handling units, exhaust fans, hoods, etc., to design requirements as shown on the airflow diagrams.
 - b. Test and record all motor full load amperes.
 - c. Test and adjust system for design CFM outside air.
 - d. Test and adjust entering and leaving air temperature, both wet bulb and dry bulb across the coils.
 - e. Adjust all zones to proper design CFM; supply, return and exhaust.
 - f. Test and adjust each ceiling diffuser, supply register, return air wall and return/exhaust register to design requirements.
 - g. Acceptance. Terminal air distribution devices shall be balanced to within 10% of design requirements.
 - h. Provide duct traverses of all main supply, return and exhaust mains entering and leaving AHU's, exhaust fans and fan coil units. Provide sketches as required to clearly indicate where measurement was taken from
- H. After completion of the balancing and adjusting of the air systems, six (6) copies of a report showing the following information shall be submitted to the Engineer for review and approval. The report shall be arranged as follows:
1. Location of each outlet or inlet shown on an up-to-date plan view of each area.
 2. Dimensions or size of each outlet or inlet.
 3. Type and manufacturer: Diffuser, grille, register, supply, return, exhaust.
 4. CFM of air for each outlet or inlet with corresponding velocity.
 5. Velocity of air as measured and corresponding cfm at which system has been balanced and adjusted, for each outlet or inlet.
 6. Velocity of air measured and corresponding cfm, after each complete system has been balanced and adjusted, for each main branch or zone duct at the supply fan, and the exhaust fan, as the case may be.
 7. After each complete system has been balanced and adjusted, the total cfm at fan discharge, static pressure at fan outlet, total static pressure for apparatus, fan speed, motor amperage for each phase and voltage, shall be recorded.

8. Copy of Calibration Certificates for all measuring instruments used.
9. Motors, 1/2-HP and Larger: Test at final balanced conditions and record the following data:
 - a. Manufacturer, model and serial numbers.
 - b. Motor horsepower rating.
 - c. Motor rpm.
 - d. Efficiency rating of motor.
 - e. Nameplate and measured voltage, each phase.
 - f. Nameplate and measured amperage, each phase.
 - g. Starter thermal-protection-element rating.

3.3 MEASUREMENTS AND INSTRUMENTATION

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until two (2) consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.

3.4 PERFORMING ADJUSTING AND BALANCING

- A. Perform adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- B. Cut insulation and ductwork for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- C. Patch insulation, ductwork, and housings, using materials identical to those removed.
- D. Seal ducts and test for and repair leaks.
- E. Seal insulation to re-establish integrity of the vapor barrier.
- F. Mark equipment settings, including damper control positions, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- G. Adjust and balance systems subsequent to significant system modifications, and resubmit test results.

3.5 SYSTEM DEFICIENCIES

- A. This Contractor shall advise the Construction Manager/Owner of all system deficiencies in writing. Report missing dampers, controls, etc.
- B. Upon completion of system deficiencies, Balancing Contractor shall balance and record data.

+ + END OF SECTION 239900 + +

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1.0 GENERAL

1.1 DESCRIPTION

- A. The intent of this section is to specify the commissioning responsibilities of the Heating Ventilation and Air Conditioning trade Contractor (HVAC); Electrical trade Contractor; Testing, Adjusting, and Balancing trade Contractor (TAB); Automatic Temperature Controls trade Contractor (ATC); Plumbing Trade Contractor; and the Fire Protection trade Contractor. The Owner is required to participate in the commissioning process. The Commissioning Agents for this project will be the Owner's personnel and the Engineer of Record.
- B. The purpose of the commissioning process is to provide the Owner/operator of the facility with a higher level of assurance that the systems have been installed in the prescribed manner and will operate within the performance guidelines. It is intended to enhance the quality of the building start-up and aid in the orderly transfer of the building and systems to beneficial use by the owner. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
1. Verify the applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and they receive adequate operational checkout by installing contractors.
 2. Verify and Document proper performance of equipment and systems.
 3. Verify that O&M documentation left on site is complete.
 4. Verify that the Owner's operating personnel are adequately trained.
- C. The Commissioning work will begin only after all systems are 100% complete and functional. The factory start-up of all equipment must have been carried out as well as control system completion and system checkout. Air and water balancing reports must have been submitted and approved by the design engineer. All punch list items must be complete.
- D. The Commissioning team will be made up of representatives from the Owner, Mechanical Contractor, the ATC Sub-Contractor and the Engineer of Record.
- E. The Commissioning Agent will actively participate in the construction phase of the project to assure compliance with the mechanical and electrical commissioning requirements.
- F. The Commissioning Agent is a building system specialist dedicated to advancing the building systems from a state of static completion to a state of full, demonstrated, and documented working order. The mechanical and electrical subcontractors shall provide the following information to the Commissioning Agent:
1. Completed equipment test and any system functional performance tests.
 2. Operation and maintenance manuals, as-builts, and any other items as may be specified herein for support of the HVAC and electrical systems and equipment for review and comment.

3. Information regarding the process and performance of systems within the facility.
 4. Information necessary to achieve date of acceptance for each component and system for start of warranty period.
- G. The Commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including general and supplementary conditions and other divisions of these specifications, apply to the Work of this Section.
- B. Related Sections:
1. HVAC General Conditions
 2. HVAC Control Systems
 3. Testing, Adjusting, and Balancing
 4. Electrical Drawings and Notes

1.3 RELATED WORK

- A. The commissioning activities are the primary responsibility of the Commissioning Agent secondary and support responsibilities by the Mechanical Contractor various trade Contractors. The commissioning process does not relieve the trade Contractors from participation in the process or diminish their role obligations to complete all portions of work in satisfactory and fully operational manner.
- B. The Mechanical Contractor shall verify completeness of the building envelope, perimeter and interior work that affect proper operation and control of HVAC, plumbing, fire protection and electrical equipment and systems.
- C. The Mechanical Contractor will assure participation and cooperation of the trade Contractors as required for the commissioning process.
- D. The trade Contractor will be responsible for providing labor, materials, equipment, etc., required within the scope of his specialty to facilitate the commissioning process. The trade Contractor will perform tests and verification procedures required by the commissioning process as outlined in the specifications and requested by the Commissioning Agent.
- E. The trade Contractors and their vendors shall provide assistance, when requested by the Commissioning Agent, to help develop and edit descriptions by system.
- F. The Owner will schedule personnel in the mechanical and electrical commissioning process.

1.4 SCHEDULE

- A. The Commissioning Agent will work with the Owner according to established protocols to schedule the commissioning activities. The Commissioning Agent will provide sufficient notice to the Construction Manager for scheduling commissioning activities. The Construction manager will integrate all commissioning activities into the master schedule including specific time and duration required. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
- B. A meeting shall be arranged by the Owner, prior to commissioning activities, to discuss and outline a commissioning activity work schedule. The lead tradesman for each trade, who actually performed the work, shall be present. All trades are to be present as scheduled during the commissioning process. A meeting shall take place a minimum of 60 days prior to the start of commissioning. All trades involved in commissioning shall be present along with the Owner, Engineer, Mechanical Contractor and Commissioning Agent.
- C. Commissioning of systems will proceed per criteria established in the specific sections that follow, or as the Commissioning Agent deems necessary, with activities to be performed on a timely basis. Commissioning of systems may process prior to final completion of systems to expedite progress and should have the approval of the Owner, Engineer and Commissioning Agent before starting.
- D. Problems observed shall be addressed immediately, in terms of notification to responsible parties, and actions to correct deficiencies. The Commissioning Agent will distribute a Deficiency Notice for corrective work to all parties with a response date.
- E. An equipment training schedule shall be provided by the trade Contractors which will describe the piece of equipment, expected duration of training, personnel involved and the time and date.

1.5 COMMISSIONING PROCESS

- A. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
 - 1. Commissioning during construction begins with a scope meeting conducted by the Commissioning Agent where the commissioning process is reviewed with all parties as defined in part one of this specification.
 - 2. Additional meetings will be held in conjunction with trade Contractors meetings, with the Mechanical Contractor and the trade Contractors, to plan, scope, coordinate, schedule future activities and resolve any issues.
 - 3. Equipment documentation is submitted to the Commissioning Agent during normal submittals, including detailed start-up and checkout procedures.
 - 4. The Commissioning Agent will perform periodic on site construction inspections. Any issues observed will be documented and formally passed onto the Mechanical Contractor and the trade contractors for their review and correction.

5. In general, the checkout and functional performance tests proceeds from simple to complex and from component level to equipment to system and intersystem levels with pre-functional checklists being completed before functional testing.
6. The trade contractors will execute and document the pre-functional checklists and perform start-up and initial check out. The commissioning Agent documents that the check list and start up were completed according to the approved plans. This will include the Commissioning Agent witnessing start-up of the selected equipment.
7. The Commissioning Agent will review the job specific "Sample" Air and Water Balancing report. The sample report will be submitted to the engineer and commissioning agent for review and comment prior to any air and balancing work beginning.
8. The Mechanical Contractor will coordinate a Pre-balancing meeting with all pertinent parties prior to any balancing work. The Commissioning Agent will conduct this meeting and discuss all issues and testing protocols associated with the testing and balancing.
9. The Commissioning Agent will track all deficiencies and their corrections for purpose of re-testing and documenting their completion.
10. Items of non compliance in material, installation or set up are to be corrected by the installing contractors and the system will be retested.
11. The Commissioning Agent reviews one master set (compiled by the Mechanical Contractor) of the O&M documentation for completeness.

1.6 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process are provided in this section. Their responsibilities are listed here to clarify the commissioning process.
- B. All Parties:
 1. Follow the commissioning plan: (The commissioning plan is an informational document that clarifies how the commissioning process shall proceed. The plan is developed by the Commissioning agent and outlines the responsibilities of the commissioning agent, owner as well as what services will be required of the design team, construction manager and the trade contractors. This document fully describes the process that will be used to carry out commissioning).
 2. Attend additional meetings in conjunction with trade contractor meetings, with the Mechanical Contractor and the trade contractors, to plan, scope, coordinate, schedule future activities and resolve any issues.
- C. Architect/Engineer – Construction and Acceptance Phase:
 1. Attend the commissioning scoping meeting and selected commissioning team meetings.

2. Perform normal submittal review and construction observation as contracted.
3. Coordinate resolution of system deficiencies identified during commissioning according to the contract documents.
4. Provide the commissioning agent with a copy of all bulletins, sketches, RFI's, Addendums and any project document updates to help keep the commissioning plan up to date.

D. Commissioning Agent – Construction and Acceptance Phase

1. The commissioning agent is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The commissioning agent may assist with problem solving, non-conformance or deficiencies but, ultimately that responsibility resides with the Mechanical Contractor, trade contractors, and Architect/Engineer. The primary role of the commissioning agent is to develop and coordinate the testing plan manual, to observe and document performance – which systems are functioning in accordance with the documented design intent and in accordance with the contract documents. The trade contractors will provide all tools or the use of tools to start, checkout and functionally test equipment and systems, except for specified testing with portable data loggers, which shall be supplied and installed by the commissioning agent.
2. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
3. Request and review additional information required to perform commissioning tasks including O&M materials, contractor start-up and check out procedures.
4. Before start-up, gather and review the current control sequences and interlocks and work with the trade contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
5. Review normal trade contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with architect/engineer reviews.
6. Overview the development of an enhanced start-up and initial systems checkout plan with subs.
7. Perform site visits to observe component and system installation. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/ substitutions relating to the commissioning process. Assist in resolving any discrepancies.

8. Verify pre-functional tests and checklists completion by reviewing pre-functional check list reports and by selected site observation.
 9. Verify systems start up by reviewing start-up reports and by selected site observation.
 10. Review testing, adjusting, and balancing execution plan and sample report.
 11. Verify air and water systems balancing by reviewing completed reports and by selected site observation.
 12. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
 13. Maintain a master deficiency and resolution log and a separate testing record. Provide the construction manager with written progress reports and test results with recommended actions.
 14. Review and approve the preparation of the O&M manuals (one master set)
- E. Owner – Construction and Acceptance Phase:
1. Review the final Commissioning plan.
 2. Attend a commissioning scoping meeting and other commissioning team meetings.
 3. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the Commissioning Agent.
 4. Review the functional performance test procedures submitted by the commissioning agent prior to testing.
 5. When necessary, observe and witness pre-functional checklists, startup and functional testing of selected equipment.
 6. Review commissioning progress and deficiency reports.
 7. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
 8. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the commissioning agent to facilitate the commissioning process.
- F. Mechanical Contractor – Construction and Acceptance Phase:
1. Review the final commissioning plan
 2. Attend a commissioning scoping meeting and other commissioning team meetings.

3. Perform the normal review of trade contractor submittals.
4. Review the functional performance test procedures submitted by the commissioning agent, prior to testing.
5. When necessary, observe and witness pre-functional checklists, start up and functional testing of selected equipment.
6. Coordinate and schedule the training of owner personnel.
7. Ensure that all trade contractors and lower tier contractors execute their commissioning responsibilities according to the contract documents and schedule.
8. Gather O&M manuals, according to the contact documents, including clarifying and updating the original sequences of operation to as-built conditions.
9. Arrange for facility operating and maintenance personnel to attend various field commission activities and field training sessions according to the commissioning plan – Construction Phase.

1.7 SCOPE OF WORK

- A. The work included under this section includes a complete and thorough investigation of the mechanical and electrical systems in order to insure proper installation and operation of all components and systems. The following systems will be commissioned by the Mechanical Contractor and witnessed by the Owner.
 1. All RTU and ACU systems
 2. All exhaust fan systems
 3. Direct Digital Control (DDC) systems and gas detection system associated with the equipment listed above.
 4. Verification of the air balancing associated with the equipment listed above.

2.0 PRODUCTS

2.1 TEST EQUIPMENT

- A. All industry standard test equipment required for performing the commissioning tests specified herein shall be provided by the trade contractor, with proprietary equipment-specific test equipment to be provided by the manufacturer.
- B. The trade contractor instrumentation shall meet the following standards.
 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required to determine adequate performance.

2. Be calibrated on the manufacturers recommended intervals with calibration tags permanently affixed to the instrument being used.
3. Be maintained in good repair and operating condition throughout the duration of use on this project.
4. Be recalibrated/repared if dropped and/or damaged in any way since last calibrated.

3.0 EXECUTION

3.1 SYSTEM COMMISSIONING

- A. The following procedures shall be verified during the commissioning process. All procedures are to be checked and carried out by the trade contractor prior to the functional testing of equipment.

3.2 INSTALLATION VERIFICATION

- A. Before any system start-ups begin, the Mechanical Contractor shall conduct a final installation verification audit for their work. The trade Contractor shall be responsible for completion of all work including change orders and punch list items to the owner's satisfaction. This Visual check of the various systems to be commissioned shall verify that all components are properly installed. The following items shall be observed:

1. Air Distribution Systems:
 - a. Mounting and support of equipment.
 - b. Noise, Vibration, air and water leaks.
 - c. Air filtration, presence and operation of dampers, diffusers, grilles, fire dampers and access doors.
 - d. Presence of thermostats and other adjustable temperature control devices.
 - e. Presence of smoke sensors and other safety devices.
 - f. Instrumentation, gauges, thermometers and flow measuring devices.
 - g. Access to equipment and filters.
 - h. Insulation of ductwork is complete.
 - i. Ductwork is sealed.
 - j. Power available to equipment.
 - k. Temperature controls are complete.
 - l. Air and water balancing is complete and a hand written report available.
2. Heating and Cooling Systems Equipment and Piping:
 - a. Service access is acceptable.
 - b. Proper cycling.
 - c. Excessive noise, vibration or leaks.
 - d. Presence of safety devices and controls.
 - e. Proper identification of all piping, valves, starters and equipment.
 - f. Pressure testing and flushing system.
 - g. Power available to equipment.
 - h. Temperature controls are complete.

- i. Equipment start-up and check out by the manufacturer representative are complete.
 - j. Air and water balancing is complete and a hand written report available.
 4. Building Electrical Systems and Equipment
 - a. Presence of safety devices and controls
 - b. Proper identification of all starters, switches and equipment.
 - c. Power available to equipment.
 - d. Equipment start-up and checkout by the manufacturer's representatives are complete.
- B. If any work is found incomplete, incorrect, or non functional, the trade Contractor shall correct the deficiency before system start-up work proceeds.

3.3 SYSTEM START-UP

- A. A start-up schedule shall be developed and submitted by the trade contractor to the commissioning agent for approval. The trade contractor shall commence with the system start-up after approval had been given to the start-up plan and after the prestart-up inspection had been completed. The commissioning agent shall witness system start-up and list all system and equipment deficiencies noted during start-up. The trade contractor shall take corrective action on all system deficiencies noted and demonstrate to the commissioning agent suitable system operation.
- B. Deficiency lists shall be prepared by owners commissioning agent in conjunction with system start-up. The deficiency list shall then be issued to the trade contractor for appropriate remedial action. The trade contractor shall advise the commissioning agent when all start-up deficiency list items have been corrected.
- C. Air and hydraulic balancing will be completed by an independent tests, adjust and balance (TAB) firm which specializes in tab work. The trade contractor shall advise the tab firm when systems are complete and ready for balancing. This work shall be started as early as possible so as to be essentially complete prior to the functional performance tests.

3.4 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Functional performance testing will commence as systems are brought to substantial completion and will be done on a system by system basis. The results of these tests will be documented and submitted to the owner for final system acceptance. Substantial completion requires that:
 1. All functional performance testing be complete and approved.
 2. Operation and Maintenance manuals are complete.
 3. All training is complete.
- B. Acceptance procedures must confirm the performance of systems to the extent of the design intent. When a system is accepted, the commissioning agent must be assured that the system

is complete, works as intended, is correctly documented, and the owners staff is trained in the operation and maintenance of the system.

- C. The objective of functional performance testing is to advance the building system from a state of substantial design completion to full dynamic operation in accordance with the specified design requirements and design intent.
- D. The commissioning agent shall attain this objective by developing individual systems testing protocols which, when implemented by the trade Contractor, will allow the commissioning agent to observe, evaluate, identify deficiencies, recommended modifications, adjust, and document the system and systems equipment performance over a range of load and functional levels. Functional performance testing will be performed on the following systems:
 - 1. Air Distribution Systems:
 - a. The testing and balancing contractor (TAB) shall demonstrate total airflow at each piece of air handling equipment at simulated full cooling, heating and/or max/min or fresh (outside) air.
 - b. Spot checks of approx 50% of air outlets shall be made. The commissioning agent shall select outlets and the air balancing shall demonstrate a reading of that outlet. Where appropriate, the thermostat shall be adjusted to simulate full cooling, full heating etc.
 - c. The testing and balancing contractor (tab) shall demonstrate proper room static pressure with respect to the adjacent spaces.
 - d. Observe motor HP draw at selected fan motors.
 - e. Discrepancies between the balancing report and spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.
 - f. Any noted drafts or noisy air distribution devices shall be evaluated and corrective action taken.
 - g. The testing and balancing contractor (TAB) shall verify the proper calibration of temperature, pressure, and safety devices as installed on the various pieces of mechanical equipment. The testing and balancing contractor shall assist the commissioning agent in the proper setting of all temperature, pressure and safety devices.
 - h. Any balancing related problems identified during the functional testing procedures shall be addressed and corrected.
 - 2. Exhaust System
 - a. The testing and balancing contractor shall demonstrate total airflow at each exhaust fan system.
 - b. Spot checks of approximately 50% of air outlets shall be made. The Commissioning Agent shall select outlets and the air balancer shall demonstrate a reading of that outlet.
 - c. The testing and balancing contractor shall demonstrate proper room static pressure with respect to the adjacent spaces.
 - d. Observe motor HP draw at selected fan motors.

- e. Discrepancies between the balancing report and spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.
 - f. Any noted drafts or noisy air distribution devices shall be evaluated and corrective action taken.
 - g. Any balancing related problems identified during the functional testing procedures shall be addressed and corrected.
4. Automatic Temperature Controls:
- a. ATC Contractor shall demonstrate the proper operation of the temperature control sequences for each air handling systems, variable air volume boxes, boilers, chillers, pumps, exhaust and terminal heating/ cooling equipment as listed 1.7 of this section.
 - b. ATC Contractor shall demonstrate the proper sequences as they apply to the equipment listed in 1.7 of this section and as designated on the contract documents. This includes but not limited to the following:
 - 1) Occupied/ unoccupied time sequences.
 - 2) Night setback/night set-up features
 - 3) Morning warm-up sequences
 - 4) Air side economizers
 - 5) Proper control of discharge air temperature from air handling equipment including reset temperature sequences.
 - 6) Heating hot water discharge temperature control to the building systems including hot water reset.
 - 7) Proper annunciation of building alarms including fail safe controls and proper shut down of equipment.
 - 8) Proper control of all air handling equipment with respect to air volume
 - 9) Calibration of all temperature pressure and safety devices.
 - 10) Proper display of ATC graphics
 - 11) Control of automatic control valves and dampers.

3.5 EXCLUSIONS

- A. The commissioning agent is not responsible for construction means, methods, job safety, or any management function on the job site.
- B. The trade contractors will provide all technician services requiring tools or the use of tools to test adjust or otherwise bring equipment into fully operational state. The owners Commissioning Agent shall observe technicians as they complete testing, and may make minor adjustments, but shall not perform construction or technician services.

+ + END OF SECTION 239950 + +

SECTION 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**PART 1 – GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Description

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- C. Demolition work is indicated on the drawings.
- D. Roof top Make Up Air units are being removed and replaced new. Existing wiring shall be removed and replaced as indicated. Existing panelboard serving these units shall also be replaced.
- E. Bus lifts are being removed and replaced as indicated.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.3 Minimum Requirements

- A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.4 Test Standards

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.5 Qualifications (Products and Services)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 2. The Owner reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.6 Applicable Publications

- A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.7 Manufactured Products

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

1.8 Materials and Equipment Protection

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 - 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 - 3. Damaged equipment shall be repaired or replaced, as determined by the Engineer.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 Work Performance

- A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions.

1.10 Equipment Installation and Requirements

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 - 1. Where the Engineer determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
 - 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 Equipment Identification

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, separately enclosed circuit breakers, individual breakers and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires. Secure nameplates with screws.

- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:
1. Nominal system voltage.
 2. Equipment/bus name, date prepared, and manufacturer name and address.
 3. Arc flash boundary.
 4. Available arc flash incident energy and the corresponding working distance.
 5. Minimum arc rating of clothing.
 6. Site-specific level of PPE.

1.12 Submittals

- A. Submit to the Engineer in accordance with Section 01 33 23, Submittal Procedures.
- B. The Engineer's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 3. Submit each section separately.
- E. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
 2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

1.13 Singular Number

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 Acceptance Checks and Tests

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests for the equipment. Repair, replacement, and re-testing shall be accomplished at no additional cost to the Government.

1.15 Warranty

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.16 Instruction

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the Owner at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES**PART 1 - GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Description

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.3 Related Work

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

1.4 Quality Assurance

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.5 Submittals

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.

2. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.6 Applicable Publications

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-10.....Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
 - D2304-10.....Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
 - D3005-10.....Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
 - WC 70-09Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 44-14Thermoset-Insulated Wires and Cables
 - 83-14Thermoplastic-Insulated Wires and Cables
 - 467-13Grounding and Bonding Equipment
 - 486A-486B-13.....Wire Connectors
 - 486C-13Splicing Wire Connectors
 - 486D-15.....Sealed Wire Connector Systems
 - 486E-15Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
 - 493-07Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
 - 514B-12.....Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS
2.1 Conductors and Cables

- A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
 - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
 - 2. No. 8 AWG and larger: Stranded.
 - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
 - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.
- D. Color Code:
 - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 - 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

2.2 Splices

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 - 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 - 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 - 1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 - 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
 - 4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.

2.3 Connectors and Terminations

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

2.4 Wire Lubricating Compound

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 General

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes.
 - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All conductors in a single conduit shall be pulled simultaneously.
 - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 Splice and Termination Installation

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.3 Conductor Identification

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.4 Feeder Conductor Identification

- A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.5 Existing Conductors

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.6 Acceptance Checks and Tests

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 VDC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Description

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.3 Related Work

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- D. Section 26 12 19, PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS: pad-mounted, liquid-filled, medium-voltage transformers.
- E. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.4 Quality Assurance

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.5 Submittals

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Engineer.
 - 3. Certifications:
 - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.6 Applicable Publications

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
 - B1-13Standard Specification for Hard-Drawn Copper Wire
 - B3-13Standard Specification for Soft or Annealed Copper Wire
 - B8-11Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-12.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
 - 70E-15.....National Electrical Safety Code
 - 99-15.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
 - 44-14.....Thermoset-Insulated Wires and Cables
 - 83-14.....Thermoplastic-Insulated Wires and Cables
 - 467-13.....Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 Grounding and Bonding Conductors

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
- D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 Ground Rods

- A. Copper clad steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 Ground Connections

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use //zinc-plated//cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 2. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated- steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 Equipment Rack and Cabinet Ground Bars

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch)

thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 Ground Terminal Blocks

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with //zinc-plated//cadmium-plated// steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.7 Grounding Bus Bar

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 General

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 Inaccessible Grounding Connections

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 Medium-Voltage Equipment and Circuits

- A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.
- B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.

- C. Pad-Mounted Transformers:
 - 1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
 - 2. Ground the secondary neutral.
- D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

3.4 Secondary Voltage Equipment and Circuits

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 - 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
- C. Switchgear, Panelboards, and other electrical equipment:
 - 1. Connect the equipment grounding conductors to the ground bus.
 - 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
- D. Transformers:
 - 1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.

3.5 Raceway

- A. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
 - 3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
 - 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
 - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

3.6 Corrosion Inhibitors

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 Conductive Piping

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.8 Ground Resistance

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.9 Ground Rod Installation

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.10 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Description

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.3 Related Work

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.4 Quality Assurance

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.5 Submittals

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit the following data for approval:
 - 1) Raceway types and sizes.
 - 2) Conduit bodies, connectors and fittings.
 - 3) Junction and pull boxes, types and sizes.

1.6 Applicable Publications

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

- B. American Iron and Steel Institute (AISI):
S100-12 North American Specification for the Design of Cold-Formed Steel Structural Members

- C. National Electrical Manufacturers Association (NEMA):
 - C80.1-15 ... Electrical Rigid Steel Conduit
 - C80.3-15 ... Steel Electrical Metal Tubing
 - FB1-14 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - FB2.10-13. Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)
 - FB2.20-14. Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
 - TC-2-13 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
 - TC-3-13 PVC Fittings for Use with Rigid PVC Conduit and Tubing

- D. National Fire Protection Association (NFPA):
70-17 National Electrical Code (NEC)

- E. Underwriters Laboratories, Inc. (UL):
 - 1-05 Flexible Metal Conduit
 - 6-07 Electrical Rigid Metal Conduit - Steel
 - 50-15 Enclosures for Electrical Equipment
 - 360-13 Liquid-Tight Flexible Steel Conduit
 - 467-13 Grounding and Bonding Equipment
 - 514A-13 Metallic Outlet Boxes
 - 514B-12 Conduit, Tubing, and Cable Fittings
 - 651-11 Schedule 40 and 80 Rigid PVC Conduit and Fittings
 - 651A-11 Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 797-07 Electrical Metallic Tubing

PART 2 – PRODUCTS

2.1 Material

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

- B. Conduit:
 1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
 2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and NEMA C80.1.
 3. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and NEMA C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
 4. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
 8. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

- C. Conduit Fittings:
1. Rigid Steel Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 2. Electrical Metallic Tubing Fittings:
 - a. Fittings and conduit bodies shall meet the requirements of UL 514B, NEMA C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
 - d. Indent-type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
 3. Liquid-tight Flexible Metal Conduit Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
 4. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
- D. Conduit Supports:
1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
- E. Outlet, Junction, and PullBoxes:
1. Comply with UL-50 and UL-514A.
 2. Rustproof cast metal where required by the NEC or shown on drawings.
 3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

PART 3 - EXECUTION

3.1 Penetrations

- A. Cutting or Holes:
 - 1. Cutholes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Engineer prior to drilling through structural elements.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the Engineer where working space is limited.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight.

3.2 Installation, General

- A. In accordance with NEC, NEMA, UL, as shown on drawings, and as specified herein.
- B. Install conduit as follows:
 - 1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
 - 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
 - 4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 - 5. Cut conduits square, ream, remove burrs, and draw up tight.
 - 6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
 - 7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
 - 9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
- C. Conduit Bends:
 - 1. Make bends with standard conduit bending machines.
 - 2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
 - 3. Bending of conduits with a pipe tee or vise is prohibited.
- D. Layout and Homeruns:
 - 1. Install conduit with wiring, including homeruns, as shown on drawings.
 - 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Engineer.

3.3 Concealed Work Installation

- A. In Concrete:
1. Conduit: Rigid steel.
 2. Align and run conduit in direct lines.
 3. Install conduit through concrete beams only:
 - a. Where shown on the structural drawings.
 - b. As approved by the Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
 - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

3.4 Exposed Work Installation

- A. Conduit for Conductors 600 V and Below: EMT. Unless subject to physical damage.
- B. Align and run conduit parallel or perpendicular to the building lines.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.

3.6 Wet or Damp Locations

- A. Use rigid steel conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.

3.7 Motors and Vibrating Equipment

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

38 Conduit Supports

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- D. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
 - b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
 - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- E. Hollow Masonry: Toggle bolts.
- F. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- H. Attachment by wood plugs, raw plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- I. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- J. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- K. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 Related Documents

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Description

- A. This section specifies the furnishing, installation, and connection of panelboards.

1.3 Related Work

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.4 Quality Assurance

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.5 Submittals

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.

1.6 Applicable Publications

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
IBC-15International Building Code
- C. National Electrical Manufacturers Association (NEMA):
PB 1-11Panelboards
250-14Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
70-17National Electrical Code (NEC)
70E-18Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
50-15Enclosures for Electrical Equipment
67-09Panelboards
489-16Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 General Requirements

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings. Panelboards shall be Square D to match existing.
- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 100% rated, mounted on insulated supports.

- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
- J. Series-rated panelboards are not permitted.

2.2 Enclosures and Trims

- A. Enclosures:
 - 1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
 - 2. Enclosures shall not have ventilating openings.
 - 3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
 - 4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
 - 5. Include removable inner dead front cover, independent of the panelboard cover.
- B. Trims:
 - 1. Hinged "door-in-door" type.
 - 2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
 - 3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
 - 4. Inner and outer doors shall open left to right.
 - 5. Trims shall be flush or surface type as shown on the drawings.

2.3 Molded Case Circuit Breakers

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
 - 1. 120/208 V Panelboard: 10,000 A symmetrical.
 - 2. 120/240 V Panelboard: 10,000 A symmetrical.
 - 3. 277/480 V Panelboard: 65,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame.
- E. Circuit breaker features shall be as follows:
 - 1. A rugged, integral housing of molded insulating material.
 - 2. Silver alloy contacts.
 - 3. Arc quenchers and phase barriers for each pole.
 - 4. Quick-make, quick-break, operating mechanisms.

5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.

PART 3 - EXECUTION

3.1 Installation

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard after approval by the Engineer. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
- D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- E. Provide blank cover for each unused circuit breaker mounting space.

3.2 Acceptance Checks and Tests

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage and required area clearances.
 - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
 - e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 Follow-Up Verification

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

END OF SECTION

SECTION 26 29 21 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**PART 1 - GENERAL****1.1 Related Documents**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Description

- A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.3 Related Work

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.4 Quality Assurance

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.5 Submittals

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.

1.6 Applicable Publications

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):

IBC-15	International Building Code
--------------	-----------------------------
- C. National Electrical Manufacturers Association (NEMA):

FU 1-12.....	Low Voltage Cartridge Fuses
KS 1-13.....	Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):

70-17	National Electrical Code (NEC)
-------------	--------------------------------
- E. Underwriters Laboratories, Inc. (UL):

98-16	Enclosed and Dead-Front Switches
248 1-11	Low Voltage Fuses
489-13	Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS
2.1 Fused Switches Rated 600 Amperes and Less

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the open position.
3. An arc chute for each pole.
4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
8. Ground lugs for each ground conductor.
9. Enclosures:
 - a. Shall be the NEMA types shown on the drawings.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
 - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

2.2 Unfused Switches Rated 600 Amperes and Less

- A. Shall be the same as fused switches, but without provisions for fuses.

2.3 Fused Switches Rated over 600 Amperes to 1200 Amperes

- A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

2.4 Motor Rated Toggle Switches

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.5 Cartridge Fuses

- A. Shall be in accordance with NEMA FU 1.
- B. Motor Branch Circuits: Class RK1, time delay.
- C. Control Circuits: Class CC, fast acting.

2.6 Separately-Enclosed Circuit Breakers

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 Installation

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 Acceptance Checks and Tests

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 Spare Parts

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Owner.

END OF SECTION

BUS LIFT REPLACEMENT

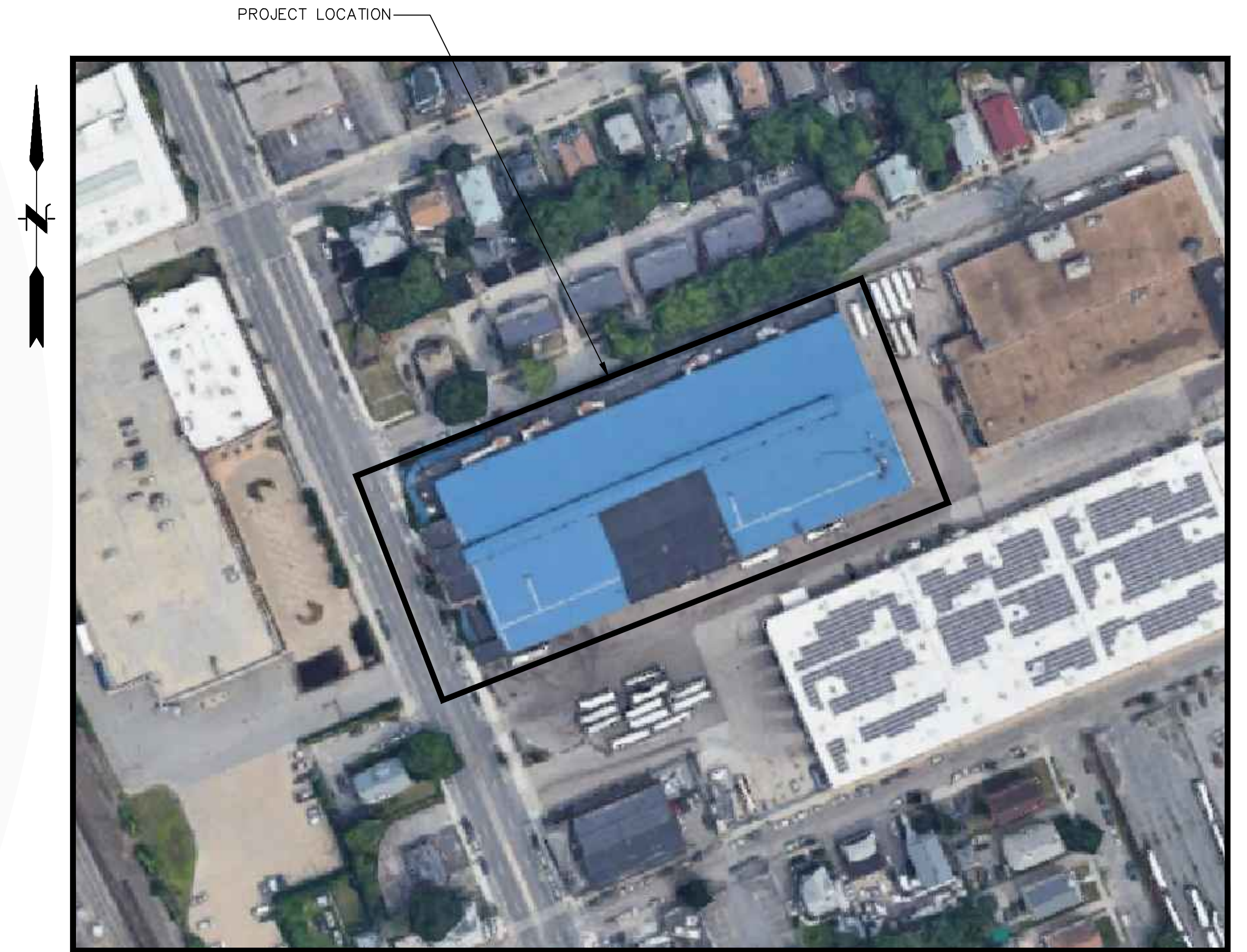
750 ELMWOOD AVE · PROVIDENCE · RHODE ISLAND

ISSUED FOR BID - FEBRUARY 10, 2020

PREPARED FOR
**RHODE ISLAND PUBLIC
 TRANSIT AUTHORITY**
 PROVIDENCE, RI



PREPARED BY
FUSS & O'NEILL
 317 IRON HORSE WAY, SUITE 204
 PROVIDENCE, RI 02908
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LOCATION MAP
 SCALE: N.T.S.

SHEET INDEX

SHEET No.	SHEET TITLE
GI-001	COVER SHEET
S-001	GENERAL NOTES AND TYPICAL DETAILS
S-002	DEMOLITION PLAN AND DETAILS
S-003	NEW WORK
S-100	PARTIAL FIRST FLOOR PLAN A
S-101	PARTIAL FIRST FLOOR PLAN B
S-102	ROOF FRAMING PLAN
M-001 - M-002	LEGEND SHEET
M-300	MAIN LEVEL - DUCT/PIPING DEMO
M-301	ROOF LEVEL - DUCT/PIPING DEMO
M-400	MAIN LEVEL - DUCT/PIPING EAST
M-400A	MAIN LEVEL - DUCT/PIPING WEST
M-401	ROOF LEVEL - DUCT/PIPING
M-600	SECTIONS & ISOMETRIC VIEWS
M-700	DETAILS
M-701	DETAILS
M-800	MECHANICAL EQUIPMENT SCHEDULE
M-900	MAU CONTROL DIAGRAM
M-901	BAS NETWORK DIAGRAM & CONTROL SEQUENCE
P-100	NATURAL GAS PIPING LAYOUT
P-101	BUILDING NATURAL GAS FLOW DIAGRAM
P-101	PLUMBING NEW WORK - SANITARY AND VENT
P-102	PLUMBING - COMPRESSED AIR
P-201	PLUMBING - SECTION VIEWS
P-501	PLUMBING DETAILS & SCHEDULES
E-001	ELECTRICAL GENERAL NOTES & LEGEND
E-002	ELECTRICAL ONE LINE DIAGRAMS
E-100 - E-101	ELECTRICAL DEMOLITION PLAN NO. 1-2
E-102 - E-103	ELECTRICAL NEW WORK PLAN NO. 1-2

PROJECT TEAM

ARDEN ENGINEERING
 CONSTRUCTORS, INC.
 505 NARRAGANSETT PARK DR.
 PAWTUCKET, RI 02861
 401-727-3500

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PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020

GI-001

GENERAL NOTES:

THE WORK SHOWN ON THESE DRAWINGS HAS BEEN DESIGNED IN ACCORDANCE WITH THE STRUCTURAL REQUIREMENTS FOR THE 2013 RHODE ISLAND STATE BUILDING CODE, EXCEPT AS AMENDED, ALTERED OR DELETED BY THE ADDITIONAL PROVISIONS IN THE CONNECTICUT SUPPLEMENT.

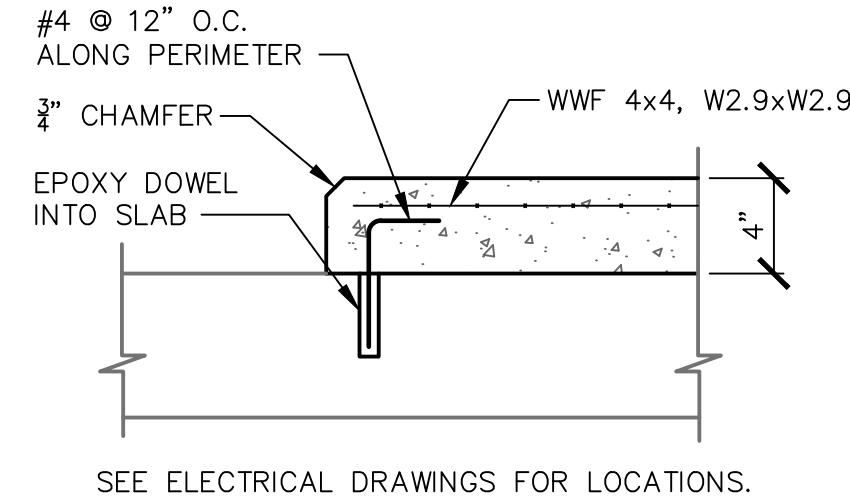
- THE STRUCTURAL COMPONENTS HAVE BEEN DESIGNED FOR THE FOLLOWING LOADS:
FLOOR LIVE: EQUIPMENT = SEE FRAMING PLANS AND EQUIPMENT DRAWINGS.
- ALL STRUCTURAL WORK SHOWN OR SPECIFIED ON THESE DRAWINGS IS SUBJECT TO REVIEW BY THE STRUCTURAL ENGINEER OF RECORD. ASPECTS OF THE WORK FOUND NOT IN CONFORMANCE WITH THE STRUCTURAL DOCUMENTS SHALL BE CORRECTED AS DIRECTED BY THE ENGINEER.
- DIMENSIONS OF EXISTING STRUCTURES SHOWN ON THESE PLANS HAVE BEEN TAKEN FROM THE ORIGINAL DESIGN DRAWINGS AND ASSUMED CORRECT, BUT ARE NOT GUARANTEED. THE CONTRACTOR SHALL VERIFY ALL EXISTING DIMENSIONS IN THE FIELD.
- THE TERM 'BEYOND' USED IN SECTION VIEWS OF STRUCTURAL ELEMENTS INDICATES THAT SAID ELEMENT IS NOT IN THE LINE OF THE SECTION CUT; HOWEVER, IT PROVIDES A GREATER UNDERSTANDING OF THE STRUCTURE.
- THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF REINFORCING STEEL AND STRUCTURAL STEEL FOR REVIEW BEFORE PROCEEDING WITH WORK. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS AND ACCEPT FULL RESPONSIBILITY FOR DIMENSIONAL CORRECTNESS. SHOP DRAWINGS SHALL BEAR THE REVIEW AND APPROVAL STAMP OF THE CONTRACTOR, IN ACCORDANCE WITH THE GENERAL CONDITIONS.
- STRUCTURAL PLANS SHALL NOT BE REPRODUCED IN WHOLE OR IN PART FOR USE AS SHOP DRAWINGS OR ERECTION PLANS. (THERE WILL BE NO RELAXATION OF THIS RESTRICTION FOR ANY TRADE).

CONCRETE NOTES:

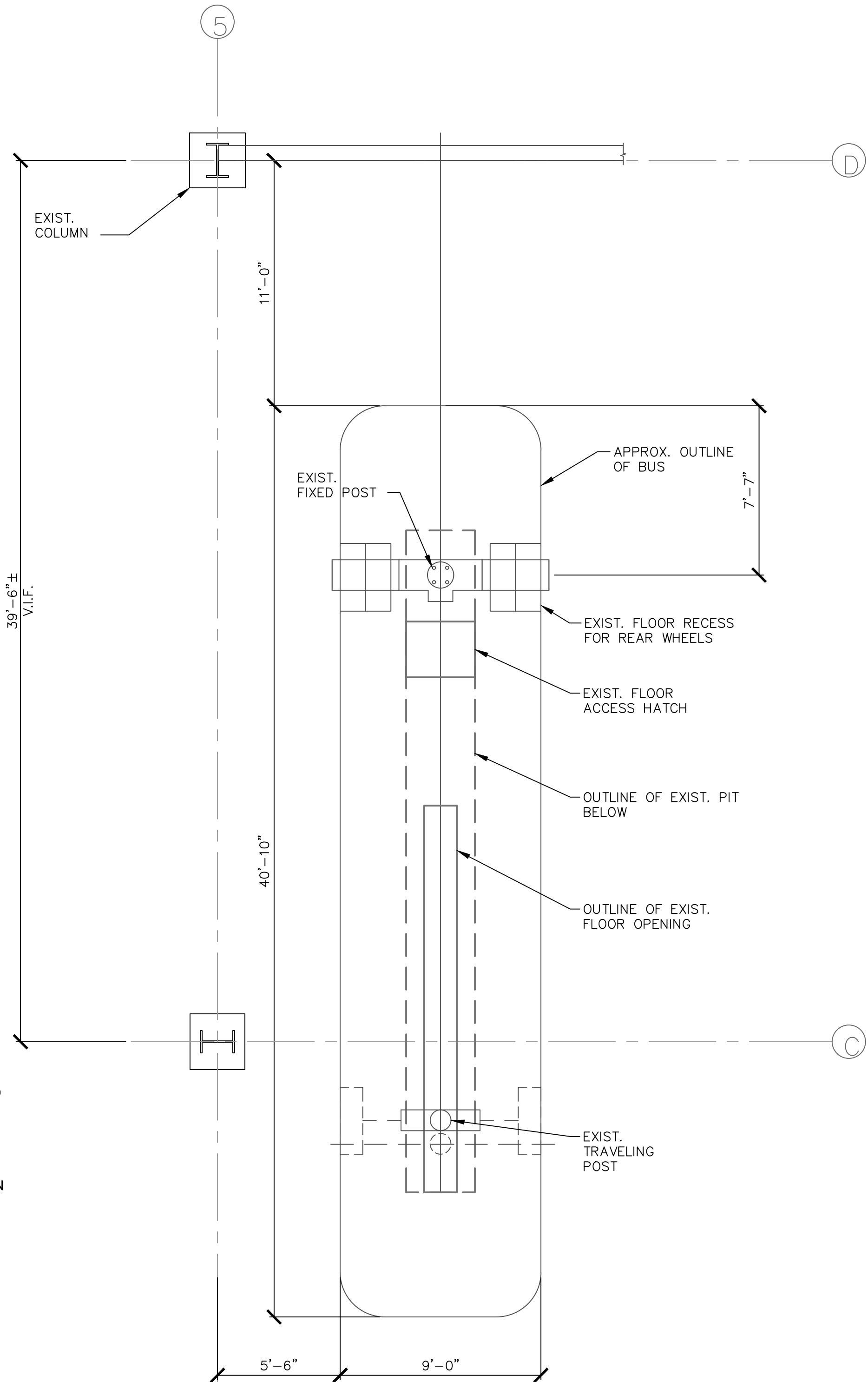
- ALL CONCRETE WORK SHALL CONFORM TO ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS".
- ALL REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60 AND BE DETAILED IN ACCORDANCE WITH ACI 315 "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES".
- REBARS SHALL HAVE A MINIMUM CONCRETE COVER AS FOLLOWS:
CONCRETE DEPOSITED AGAINST GROUND.....3 IN.
CONCRETE EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:
FOR BARS #5 AND LARGER.....2 IN.
FOR BARS SMALLER THAN #5.....1 1/2 IN.
CONCRETE NOT EXPOSED TO THE WEATHER OR THE GROUND:
SLABS AND WALLS.....3/4 IN.
- ALL REINFORCING BARS SHALL BE CONTINUOUS AND LAPPED A MINIMUM OF 48 BAR DIAMETERS AT ALL SPLICES, CORNERS, AND INTERSECTIONS UNLESS NOTED OTHERWISE.
- ALL REINFORCEMENT SHALL BE SECURELY TIED IN ITS PROPOSED LOCATION PRIOR TO AND DURING PLACEMENT OF CONCRETE USING APPROVED CHAIRS, SPACERS AND TIE WIRE AS REQUIRED. NO BARS SHALL BE CUT OR OMITTED IN THE FIELD WITHOUT THE APPROVAL OF THE ENGINEER.
- WELDED WIRE FABRIC SHALL CONFORM TO ASTM A 185, WITH A MINIMUM YIELD STRENGTH OF 75 KSI. LAP EDGES AND ENDS OF FABRIC SHEETS A MINIMUM OF ONE MESH SPACING PLUS 2 INCHES, AND WIRE TOGETHER. ALTERNATIVELY, SLABS-ON-GRADE MAY BE REINFORCED WITH FIBER REINFORCEMENT, SUCH AS FIBERMESH, APPLIED AT A DOSAGE RATE OF NO LESS THAN 1.5 LBS/CU YD.
- CONCRETE PROTECTION FOR REINFORCEMENT SHALL IN ALL CASES BE AT LEAST EQUAL TO THE DIAMETER OF THE BAR EXCEPT FOR CONCRETE SLABS.
- CONCRETE SHALL BE NORMAL WEIGHT CONCRETE AND SHALL DEVELOP A COMPRESSIVE STRENGTH OF 4,000 PSI IN 28 DAYS. CONCRETE SHALL HAVE A MAXIMUM AGGREGATE SIZE OF 3/4 INCH, A MINIMUM CEMENT CONTENT OF 560 LBS/CU YD., AND A MAXIMUM SLUMP OF 4 INCHES.
- ALL FOOTINGS AND PIERS SHALL BE CENTERED BELOW THE MEMBERS WHICH THEY SUPPORT UNLESS SHOWN OTHERWISE.
- SIZES AND LOCATIONS OF ALL REQUIRED EMBEDDED ITEMS FOR ALL TRADES SUCH AS ANCHOR BOLTS, PIPING SLEEVES, HOLDOWN ANCHORS, ETC., SHALL BE COORDINATED BY THE CONTRACTOR WITH OTHER TRADES.

STRUCTURAL STEEL NOTES:

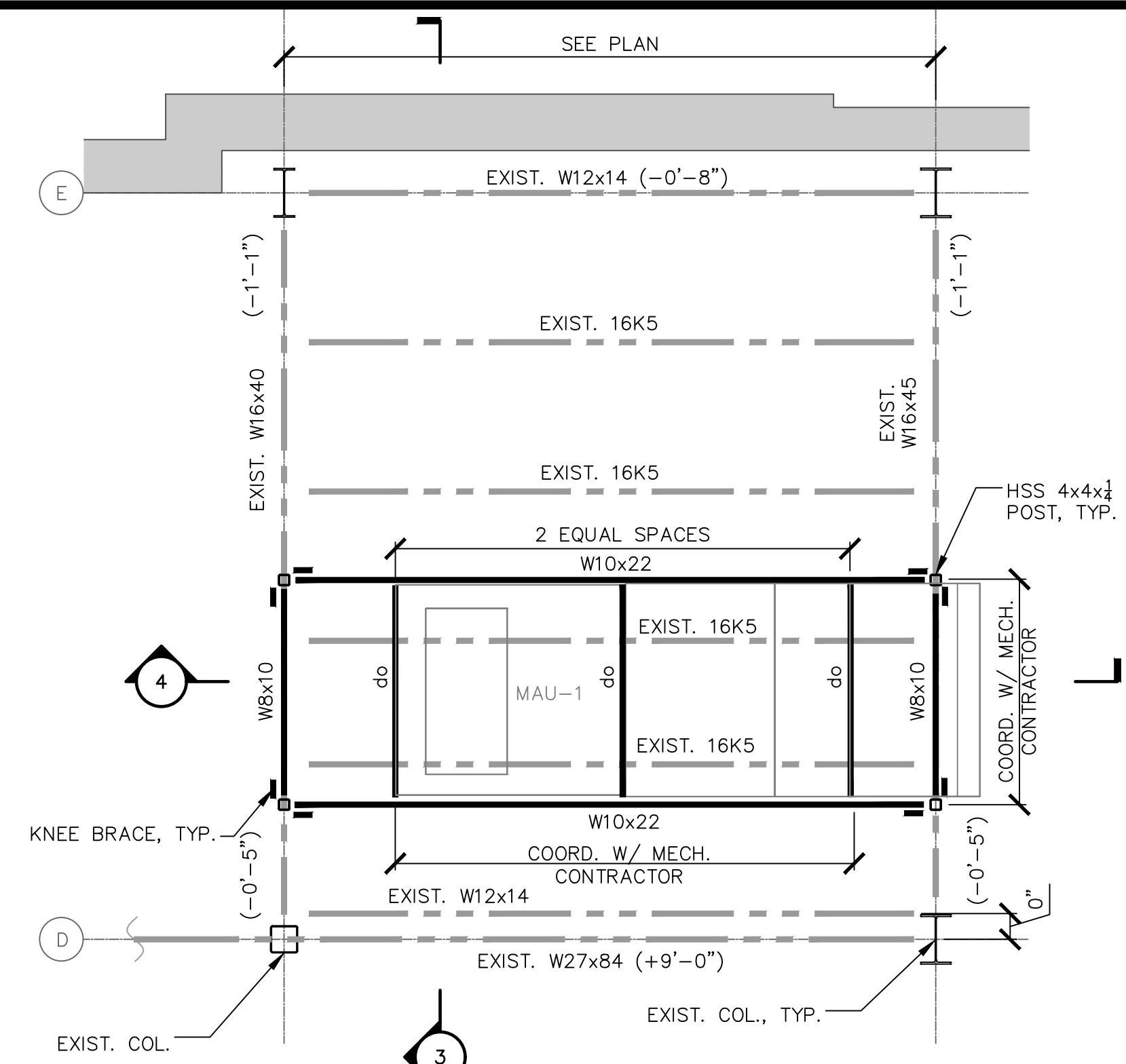
- ALL STRUCTURAL STEEL SHALL BE NEW, CLEAN, AND STRAIGHT AND SHALL BE DETAILED, FABRICATED, AND ERECTED IN ACCORDANCE WITH THE A.I.S.C. CODE OF STANDARD PRACTICE (ADOPTED MARCH 2011), EXCEPT AS MODIFIED IN THESE NOTES AND THE PROJECT SPECIFICATIONS.
- STRUCTURAL STEEL FABRICATION AND ERECTION SHALL COMPLY WITH THE BUILDING CODE, THE SPECIFICATION, AND THE "SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS (ADOPTED JUNE 22, 2010)" OF AISC.
- ALL WELDING SHALL CONFORM TO THE AMERICAN WELDING SOCIETY, D1.1-2004 STRUCTURAL WELDING CODE-STEEL.
- ALL FILLET WELDING SHALL BE A MINIMUM OF 3/8 INCH WELD UNLESS NOTED OTHERWISE ON DRAWINGS. SEE THE SPECIFICATION FOR ADDITIONAL REQUIREMENTS.
- ALL FIELD CONNECTIONS SHALL BE BOLTED EXCEPT WHERE WELDING IS SPECIFIED ON THE PLANS. BOLTS SHALL BE 3/4 INCH DIAMETER MINIMUM. BOLT HOLES FOR STEEL ANCHORED TO CONCRETE, UTILIZING CAST-IN-PLACE ANCHORS, SHALL BE BOLT DIAMETER PLUS 3/8 INCH. CONNECTIONS NOT SPECIFICALLY DETAILED ON THE PLANS SHALL BE DESIGNED FOR THE LOADS INDICATED ON THE DRAWINGS OR THOSE STATED IN THE AISC UNIFORM LOAD TABLES, WHICHEVER IS GREATER.
- PROVIDE HOLES, COPES, ETC. REQUIRED IN STRUCTURAL STEEL MEMBERS FOR WORK OF OTHER TRADES. THEY SHALL BE SHOWN ON STRUCTURAL SHOP DRAWINGS AND SHALL BE MADE IN THE SHOP. FIELD BURNING OF HOLES OR CUTS IN STRUCTURAL STEEL MEMBERS WILL NOT BE PERMITTED EXCEPT WITH THE SPECIFIC WRITTEN APPROVAL OF THE ENGINEER.
- ALL INTERIOR STRUCTURAL STEEL SHALL BE PRIMED WITH ONE COAT OF FABRICATED STANDARD PRIMER. ALL EXTERIOR STEEL SHALL BE HOT DIPPED GALVANIZED.



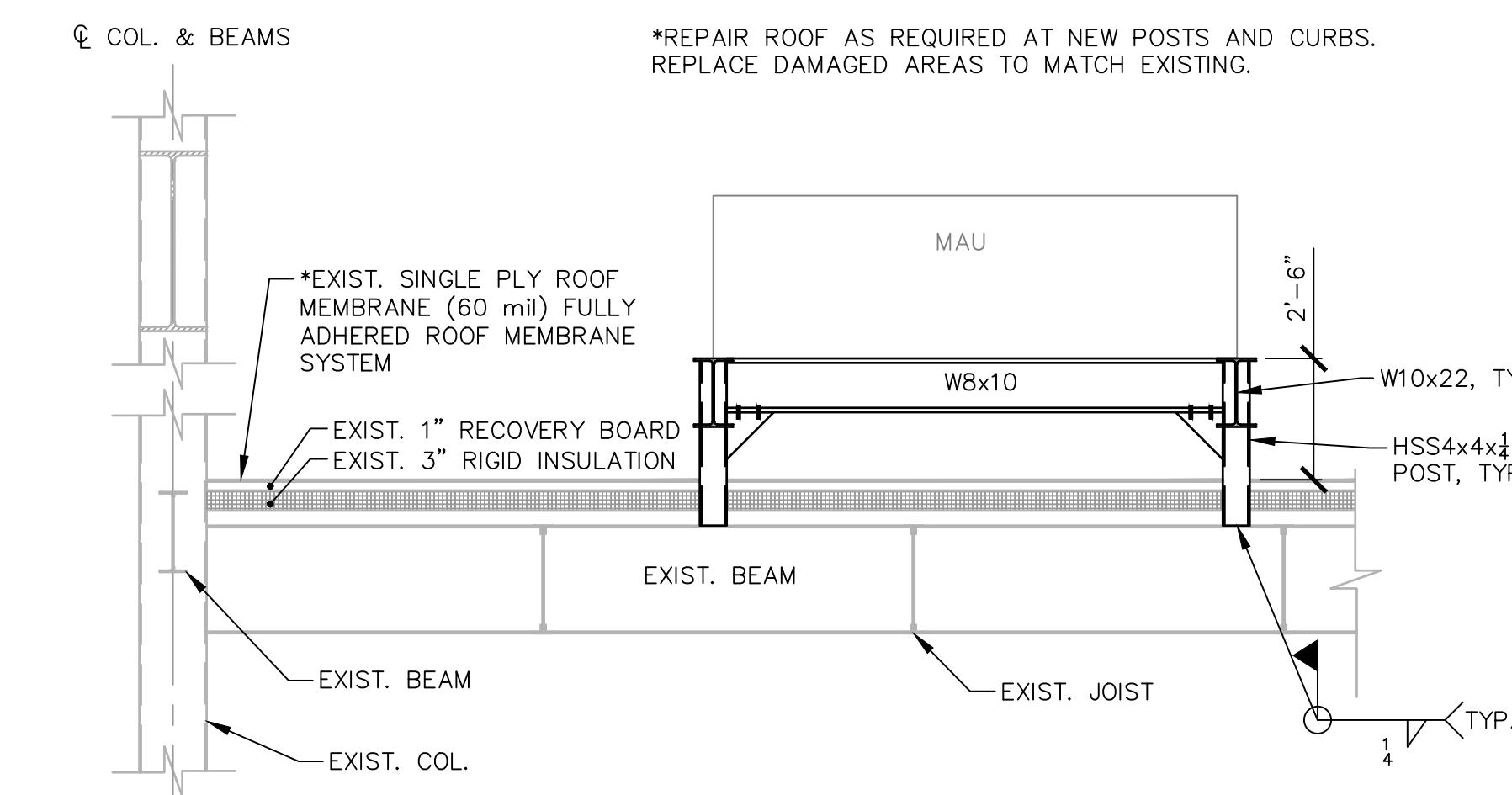
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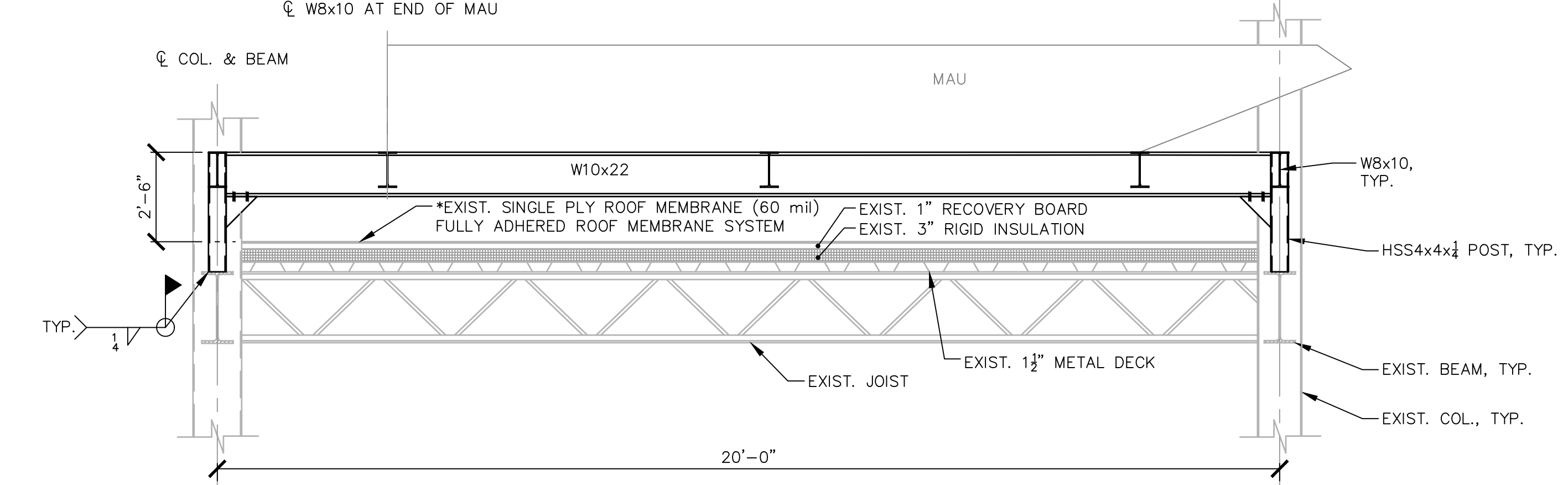
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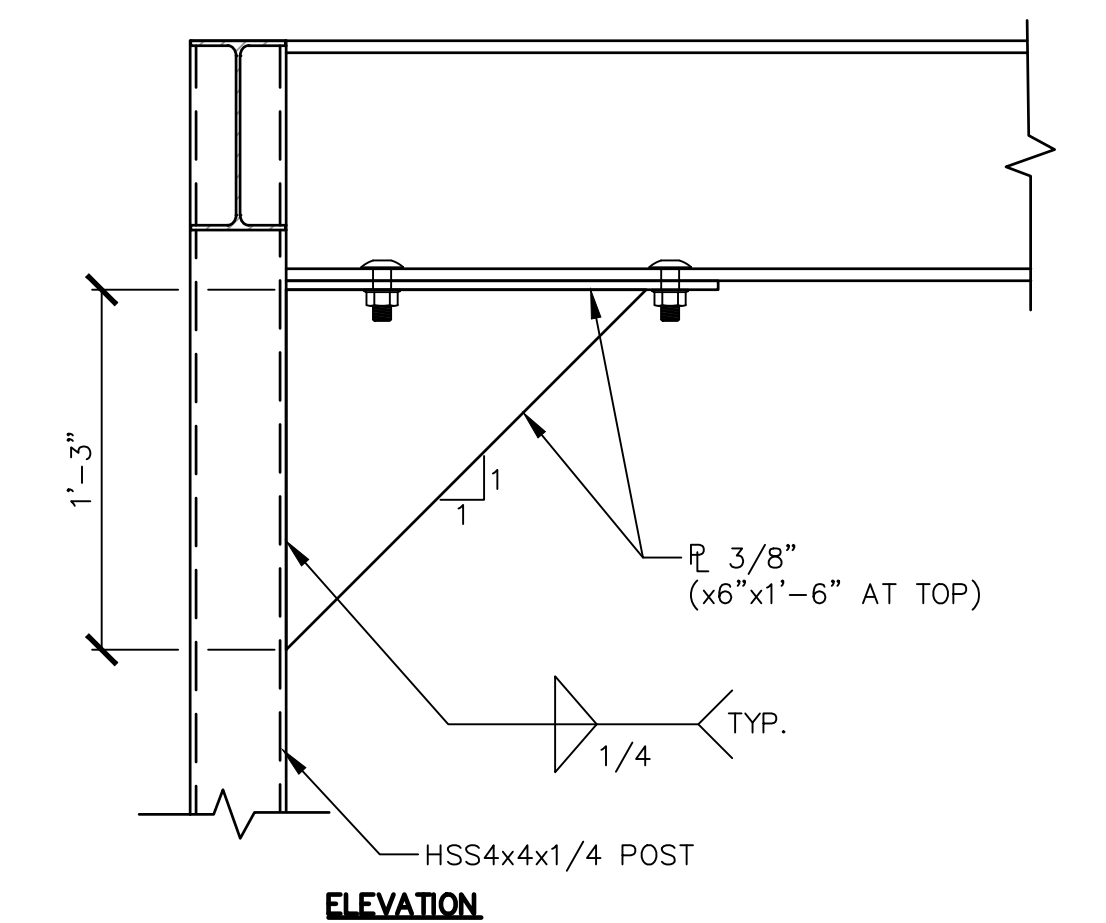
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1/4" = 1'-0"



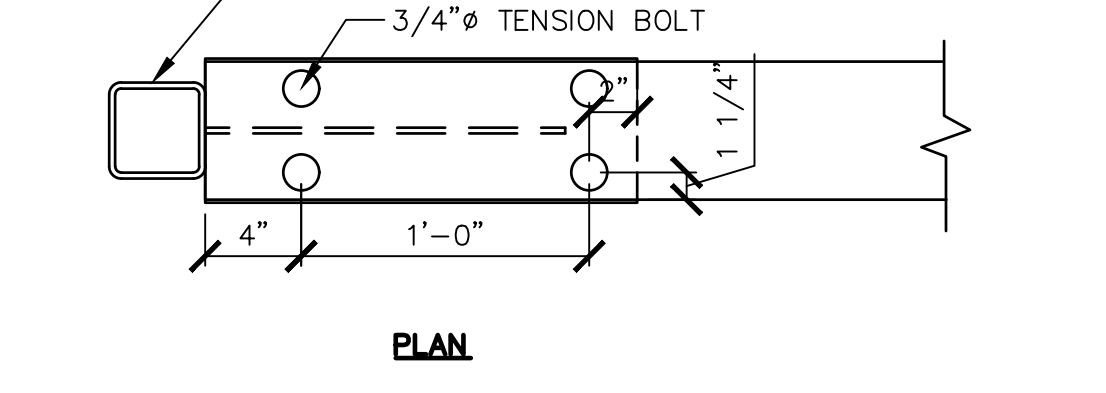
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1/2" = 1'-0"



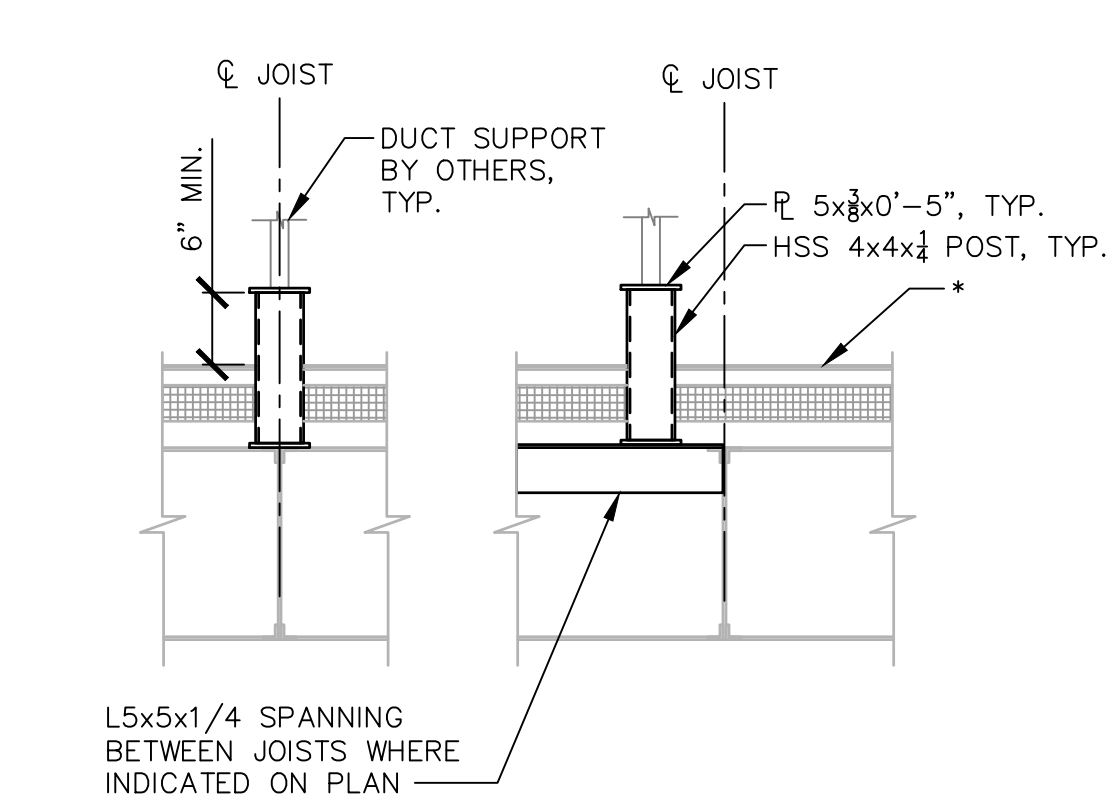
4 EQUIPMENT SUPPORT SECTION
1/2" = 1'-0"



5 TYPICAL KNEE BRACE DETAILS
1 1/2" = 1'-0"



6 DUCT SUPPORT DETAIL
3/4" = 1'-0"



7 ELEVATION

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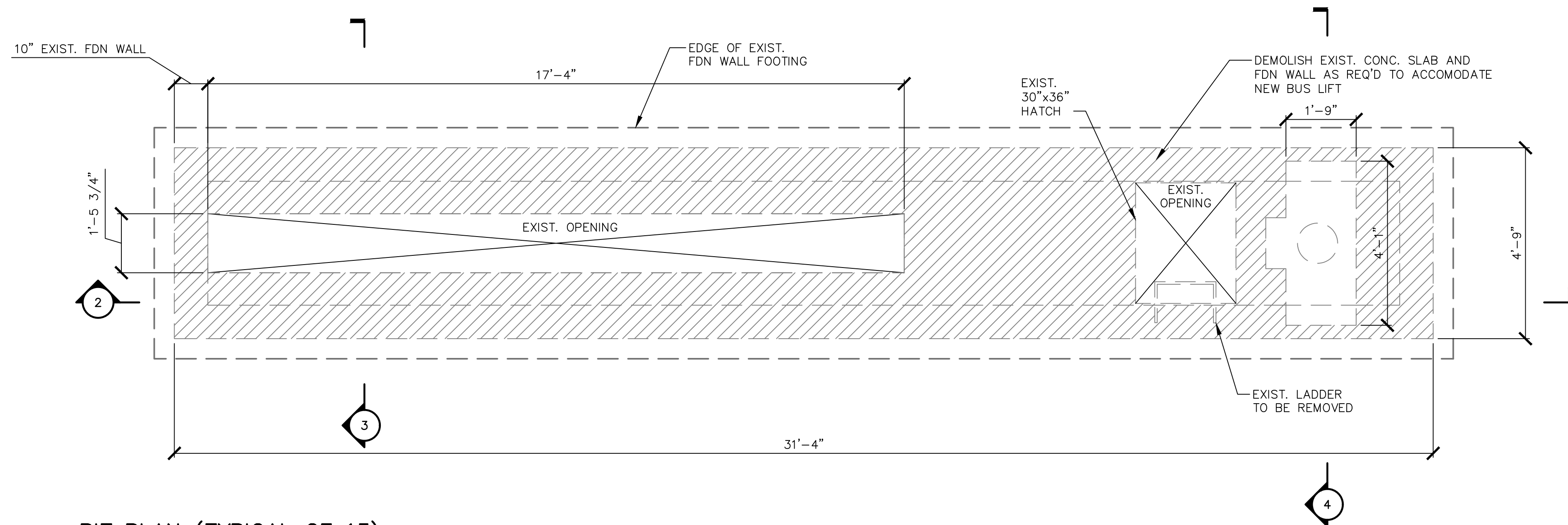
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VERT.:
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www.fando.com

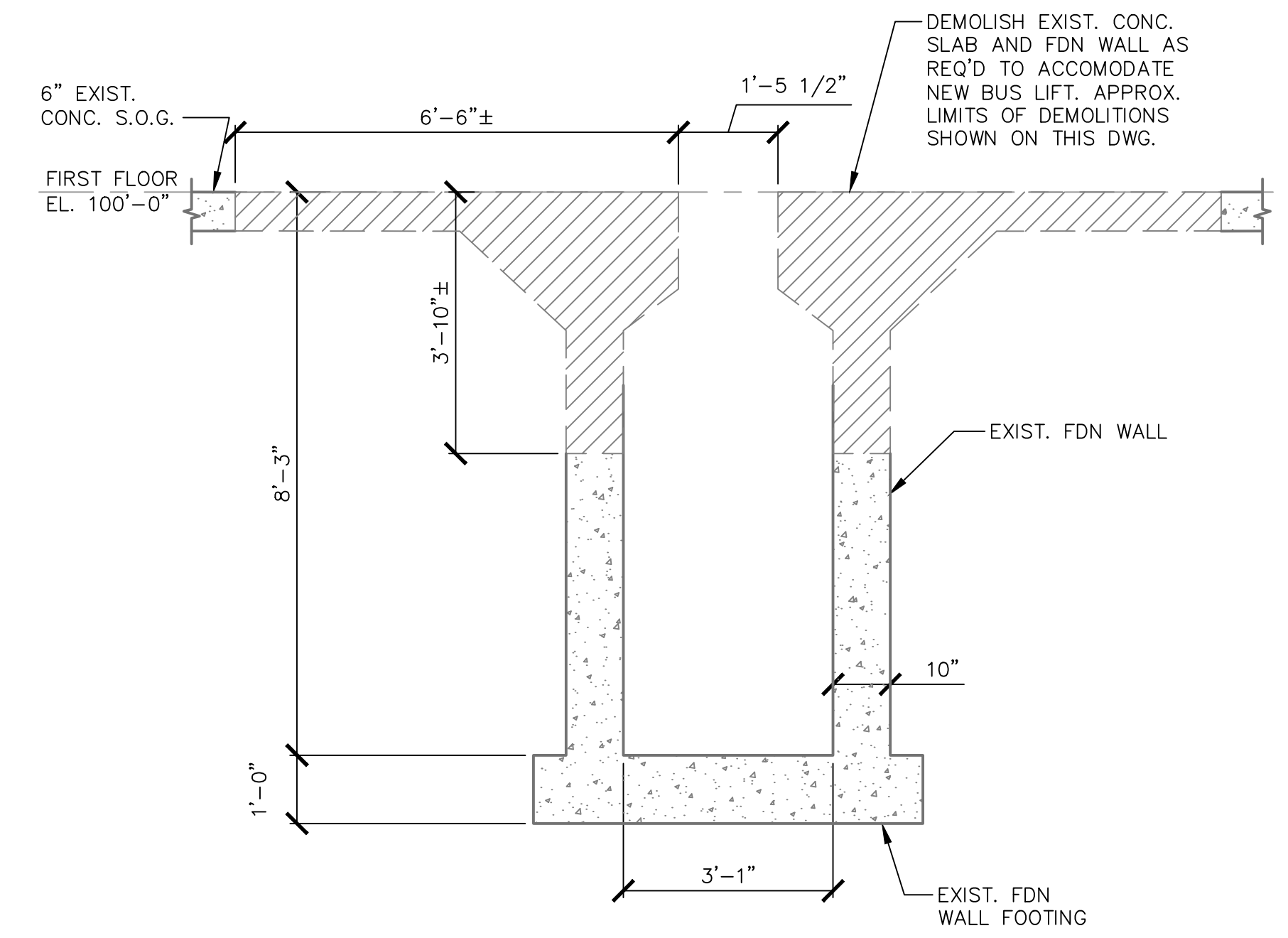
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
GENERAL NOTES AND TYPICAL DETAILS
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433_A20
DATE: FEBRUARY 10, 2020
S-001

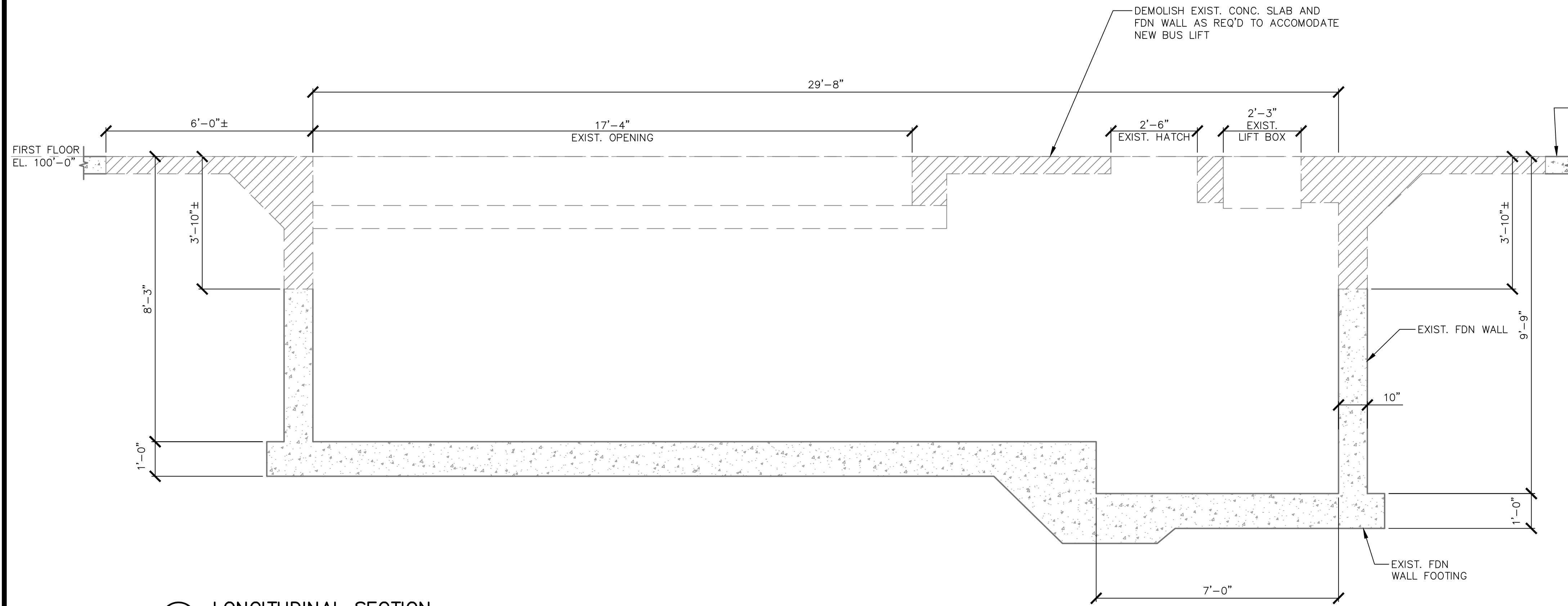
KEY:
 APPROXIMATE LIMITS OF EXISTING ELEMENTS TO BE DEMOLISHED



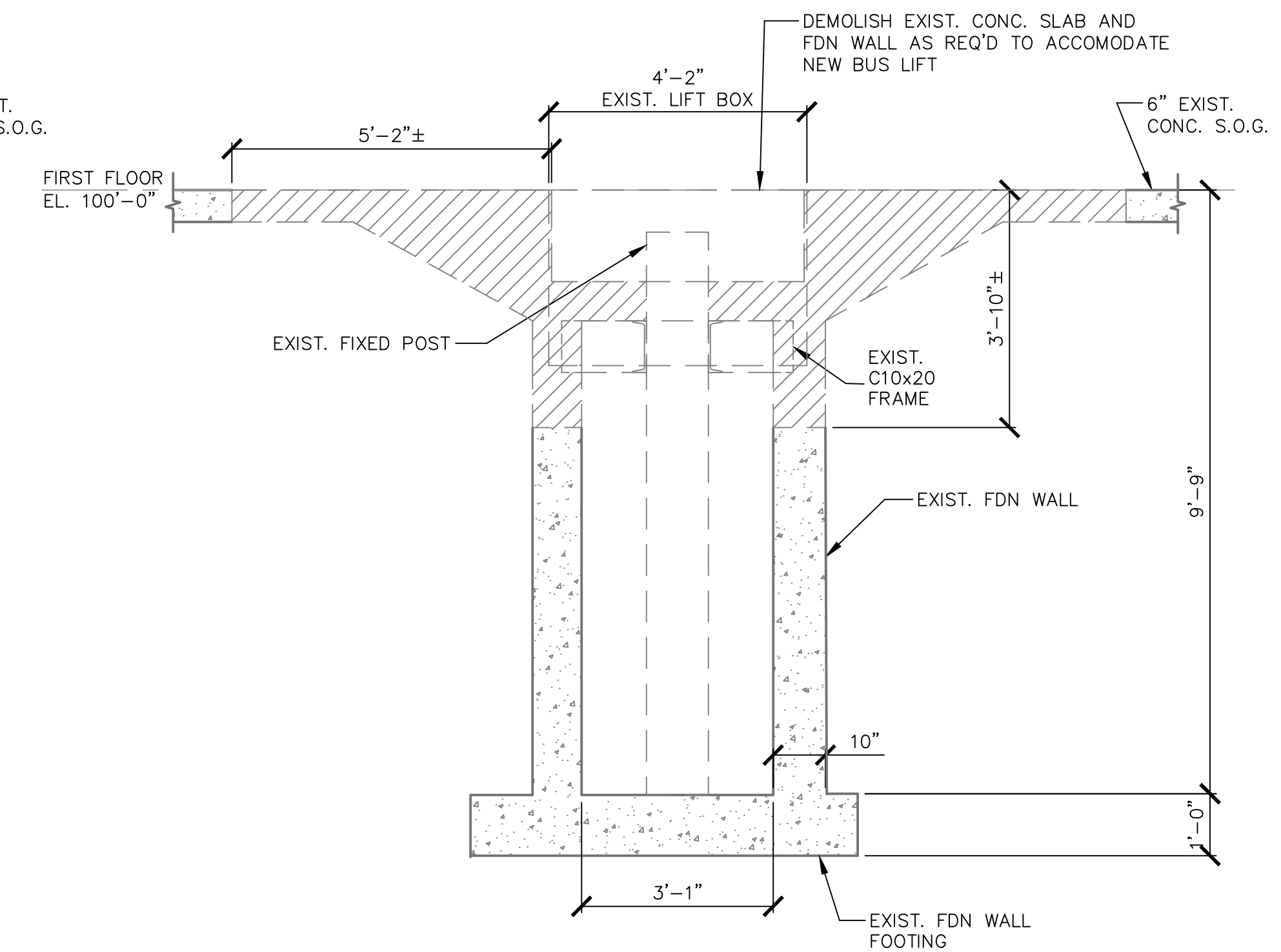
1 PIT PLAN (TYPICAL OF 13)
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3 FRONT CROSS SECTION
 1/2" = 1'-0"



2 LONGITUDINAL SECTION
 1/2" = 1'-0"



4 REAR CROSS SECTION
 1/2" = 1'-0"

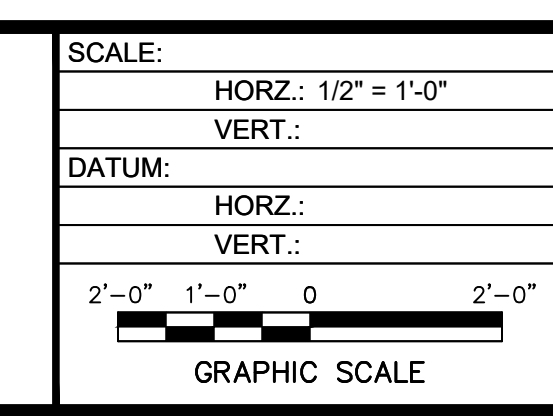
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1.	8/30/2019	100% BID DOCUMENTS	KET	RCB

SEAL

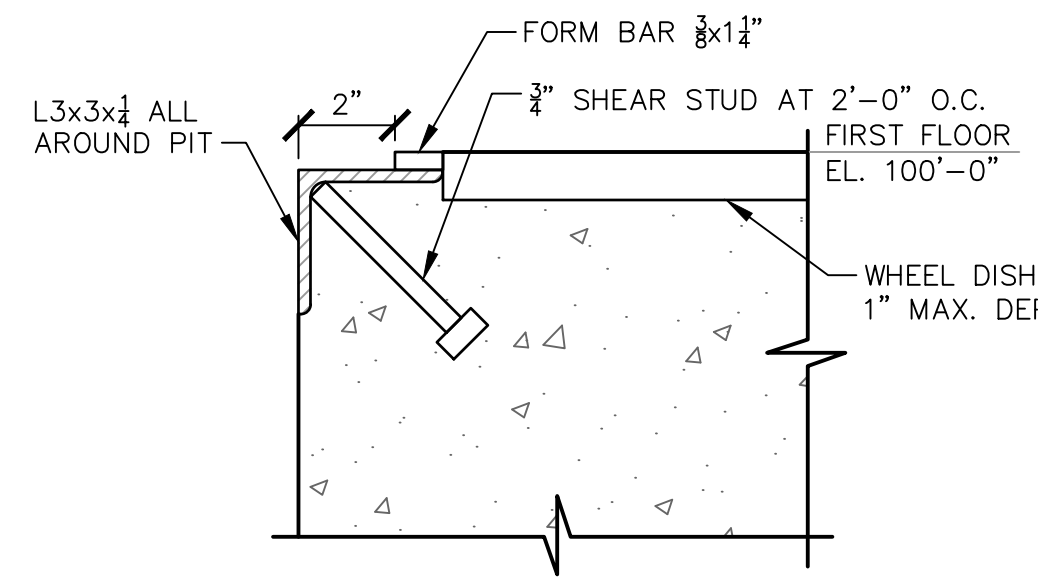
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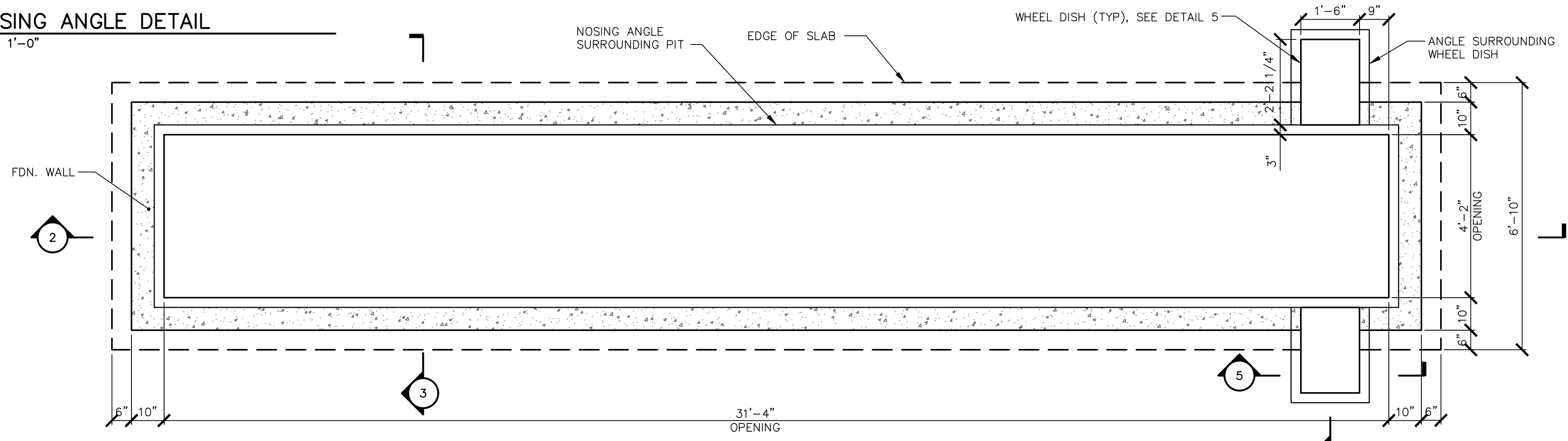

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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 DEMOLITION PLAN AND DETAILS
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

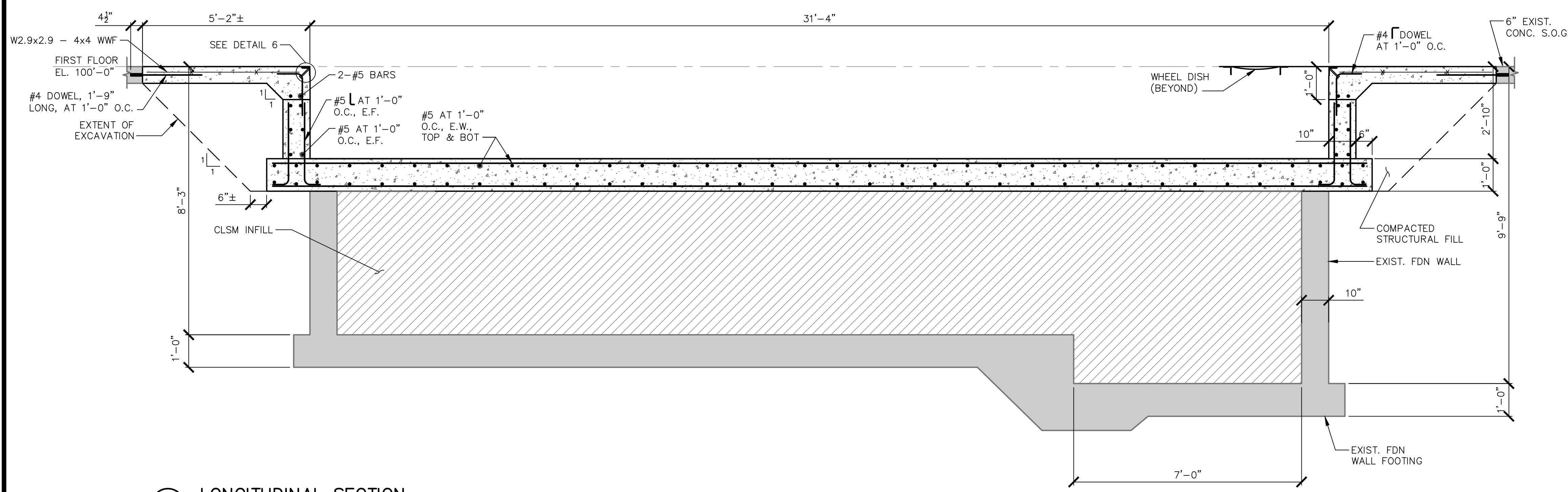
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 DATE: FEBRUARY 10, 2020
S-002



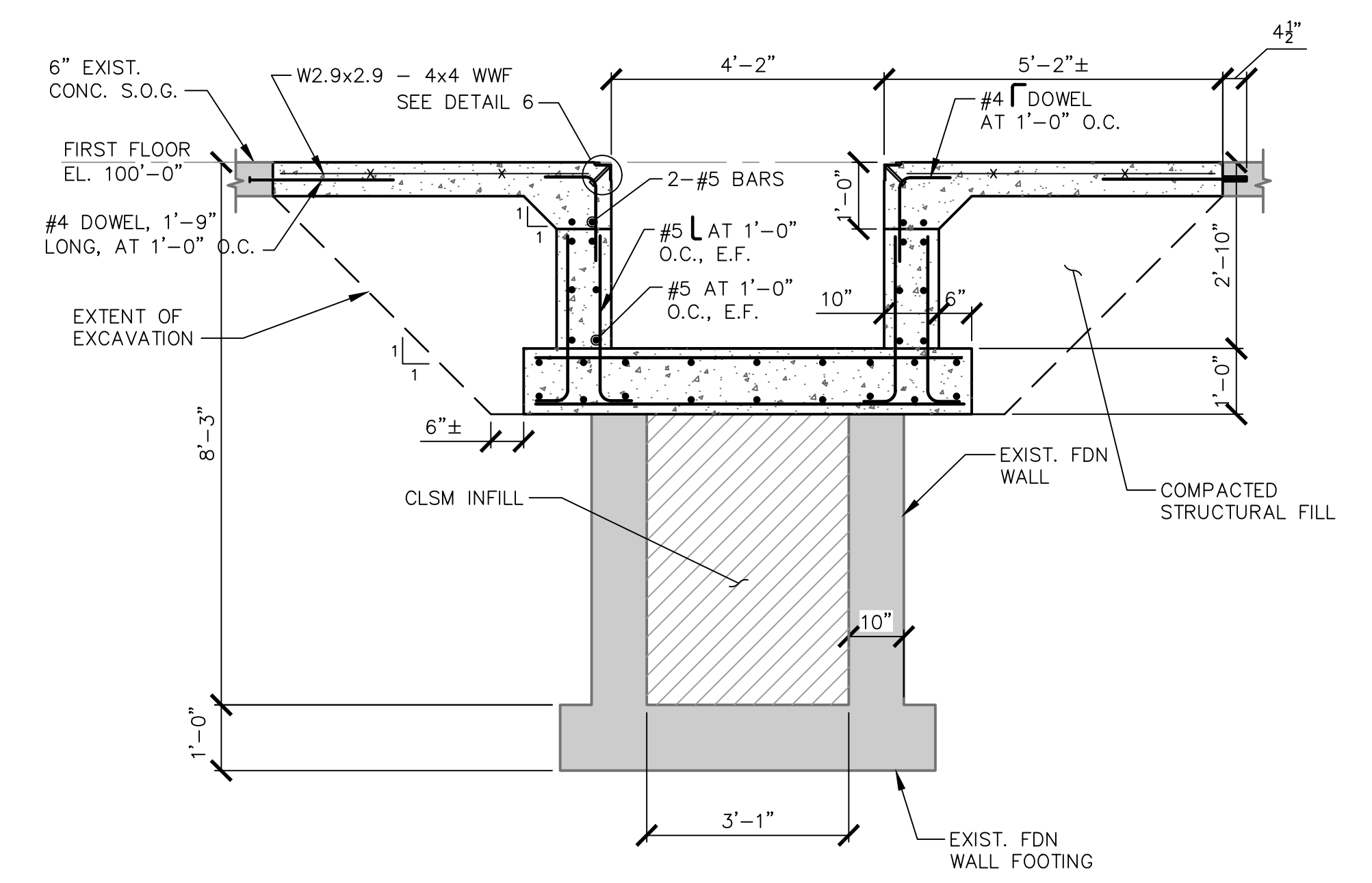
6 NOSING ANGLE DETAIL
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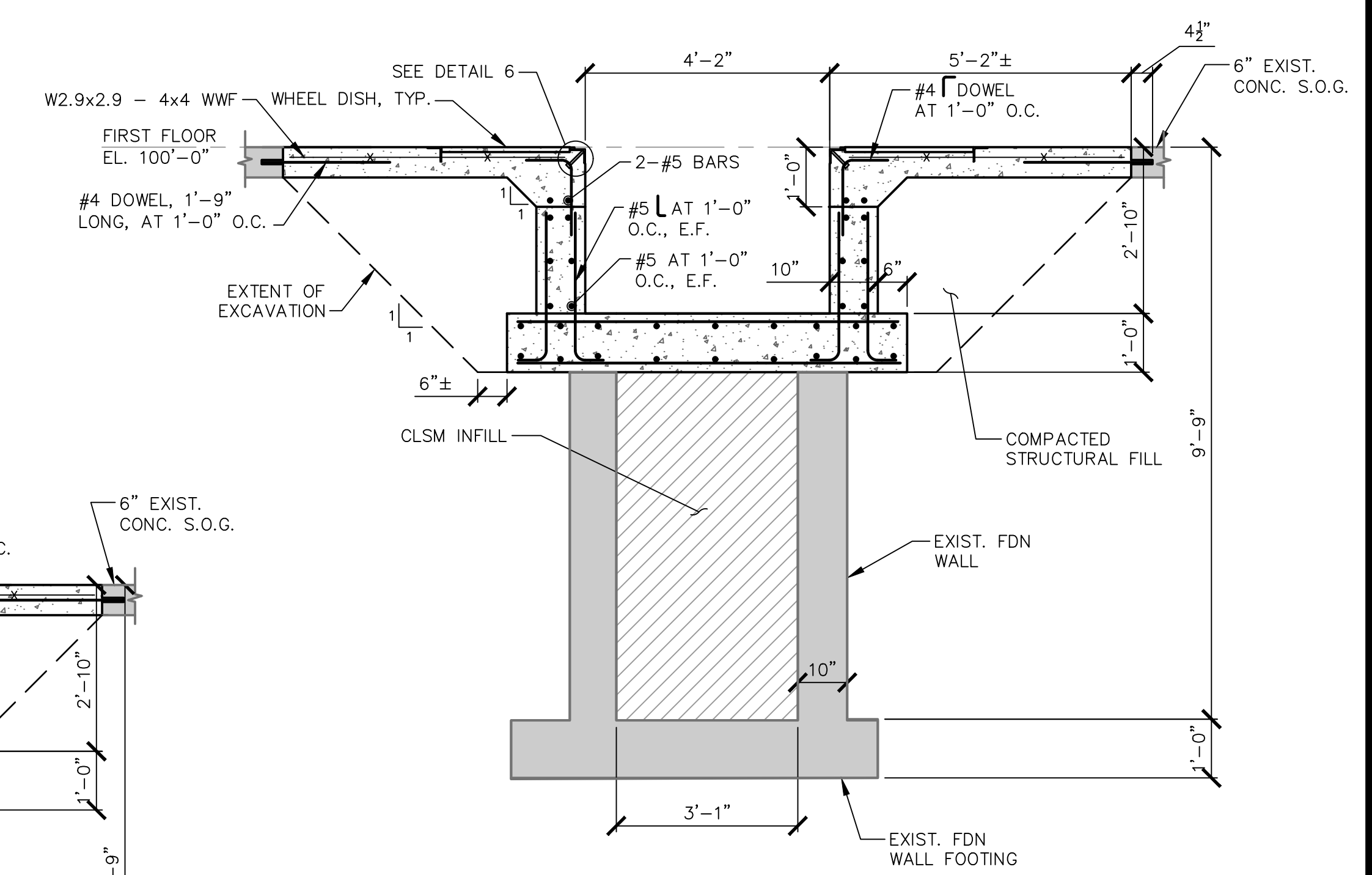
1 PIT PLAN
1/2" = 1'-0"



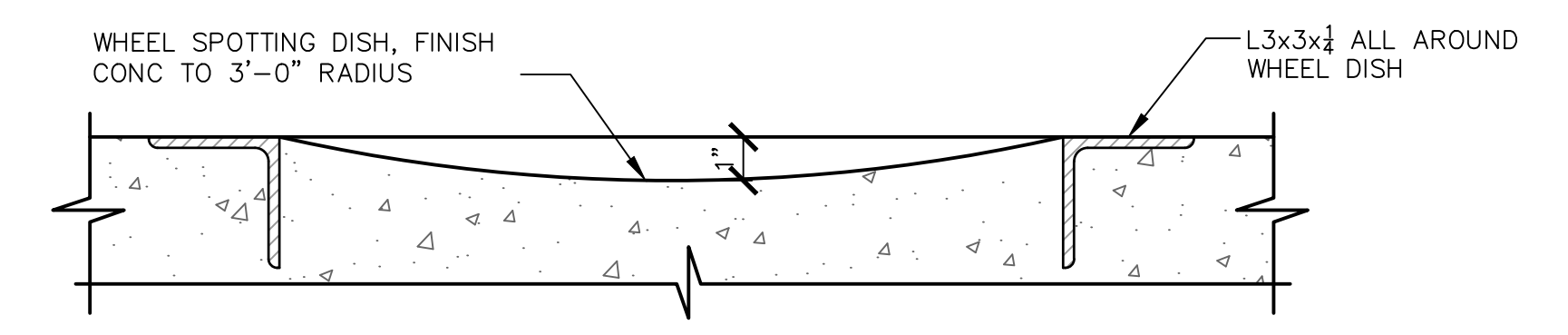
2 LONGITUDINAL SECTION
1/2" = 1'-0"



3 FRONT CROSS SECTION
1/2" = 1'-0"



4 REAR CROSS SECTION
1/2" = 1'-0"



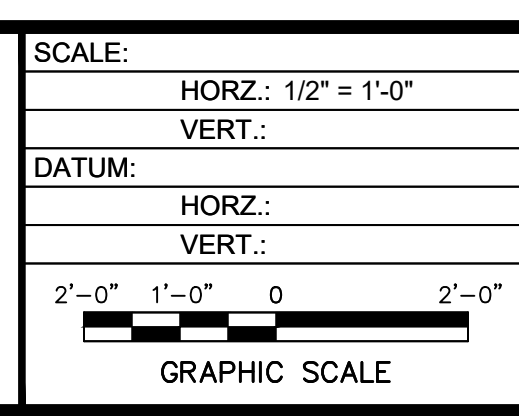
5 WHEEL DISH DETAIL
3" = 1'-0"

ISSUED FOR BID 02/10/2020

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SEAL	SEAL		

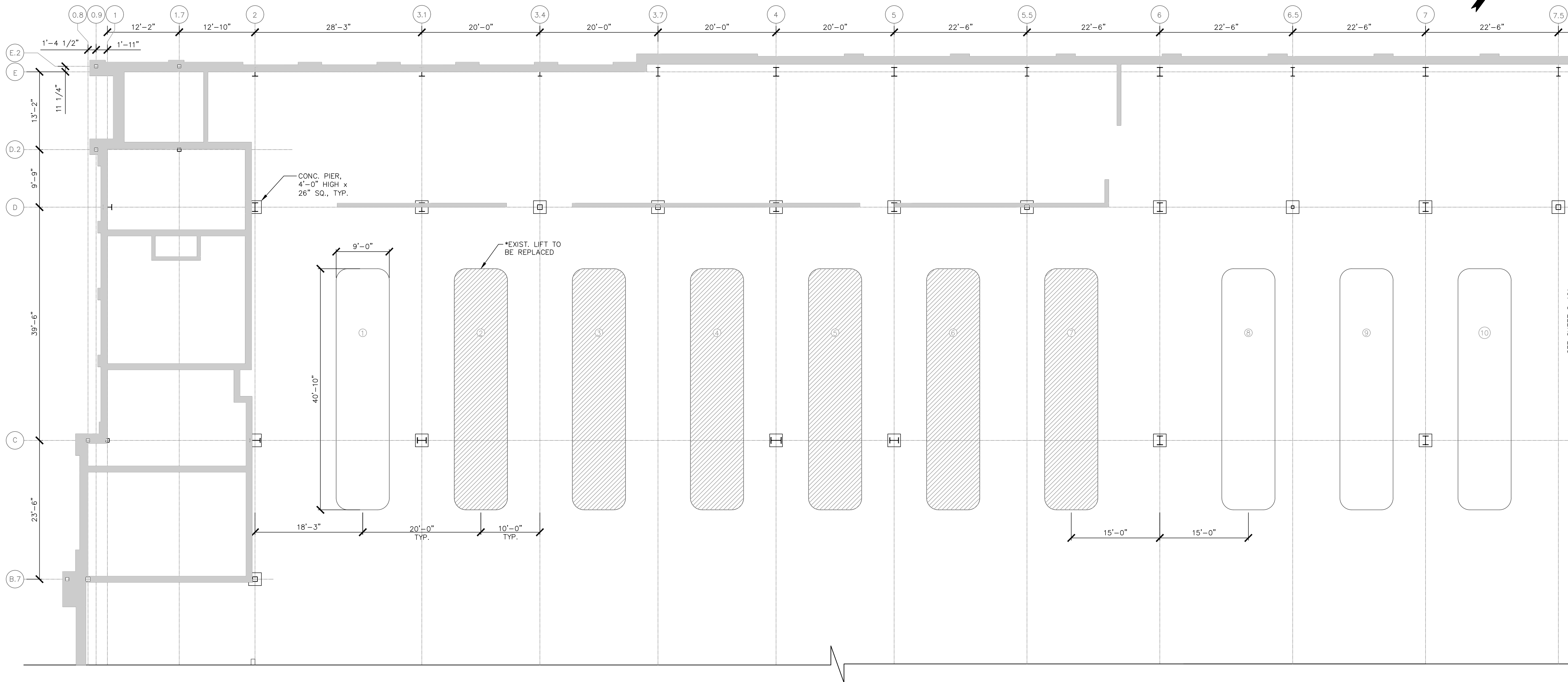


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 NEW WORK
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

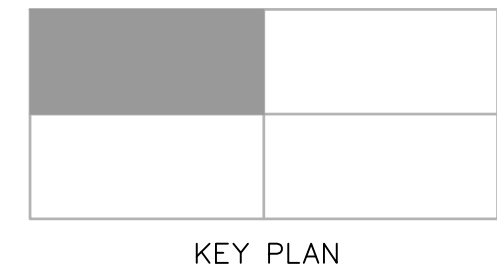
PROJ. No.: 20180433_A20
 DATE: FEBRUARY 10, 2020
S-003

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 Plotter: AUTOCAD PDF (GENERAL DOCUMENTATION) PC3 CTB File: F&O STANDARD.CTB
 LAYER STATE:



1 PARTIAL FIRST FLOOR PLAN A

1/8" = 1'-0"
 *NOTE: CONTRACT SHALL INCLUDE PRICE OF REPLACEMENT LIFTS (12 IN ALL - VERIFY WITH OWNER).

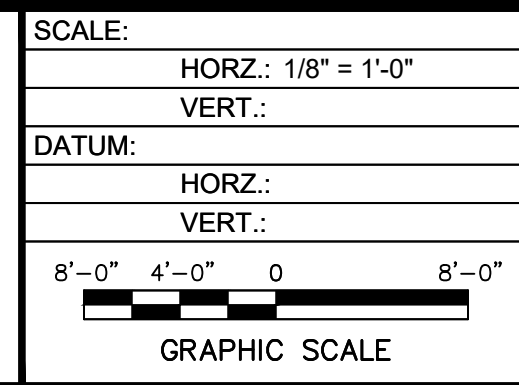


ISSUED FOR BID 02/10/2020

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
2.	2/10/2020	ISSUED FOR BID		
1.	8/30/2019	100% BID DOCUMENTS	KET	RCB

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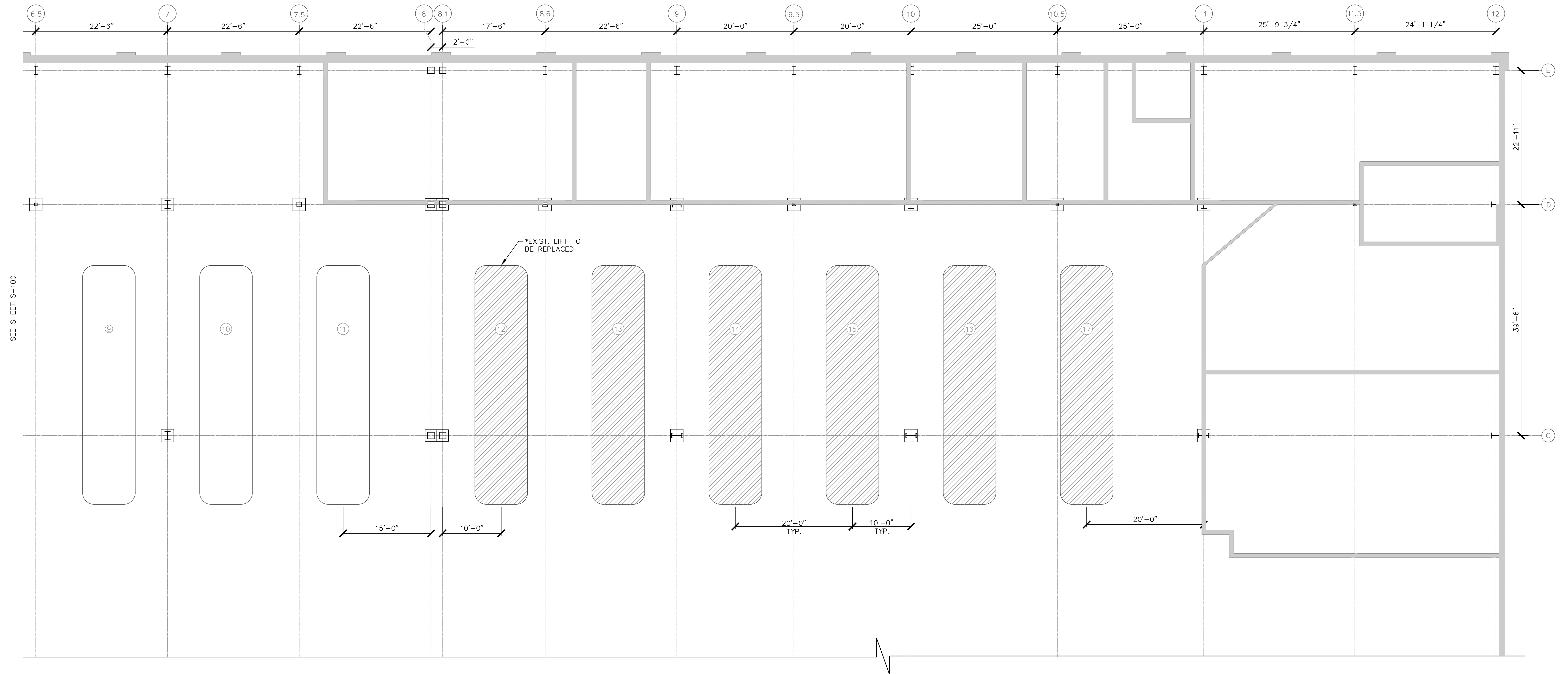
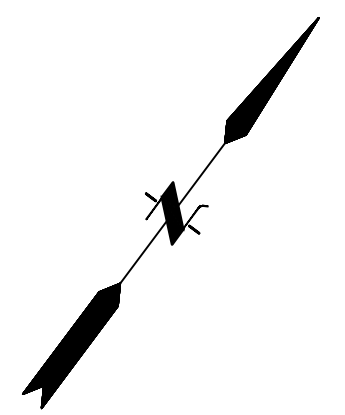
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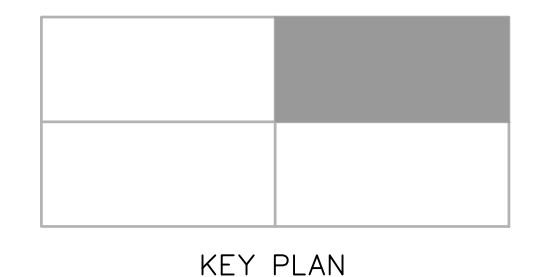
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 PARTIAL FIRST FLOOR PLAN A
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433_A20
 DATE: FEBRUARY 10, 2020
S-100



1 PARTIAL FIRST FLOOR PLAN B
1/8" = 1'-0"

*NOTE: CONTRACT SHALL INCLUDE PRICE OF REPLACEMENT LIFTS (12 IN ALL - VERIFY WITH OWNER).



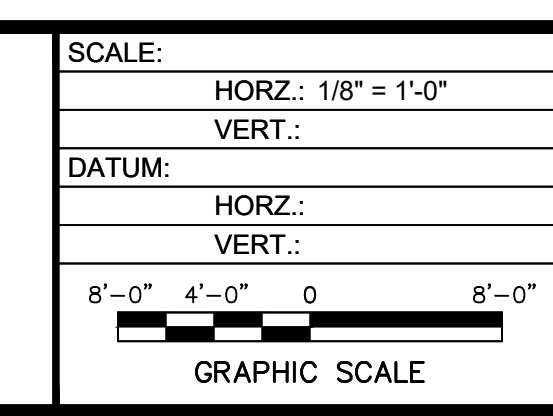
ISSUED FOR BID 02/10/2020

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1.	8/30/2019	100% BID DOCUMENTS	KET	RCB

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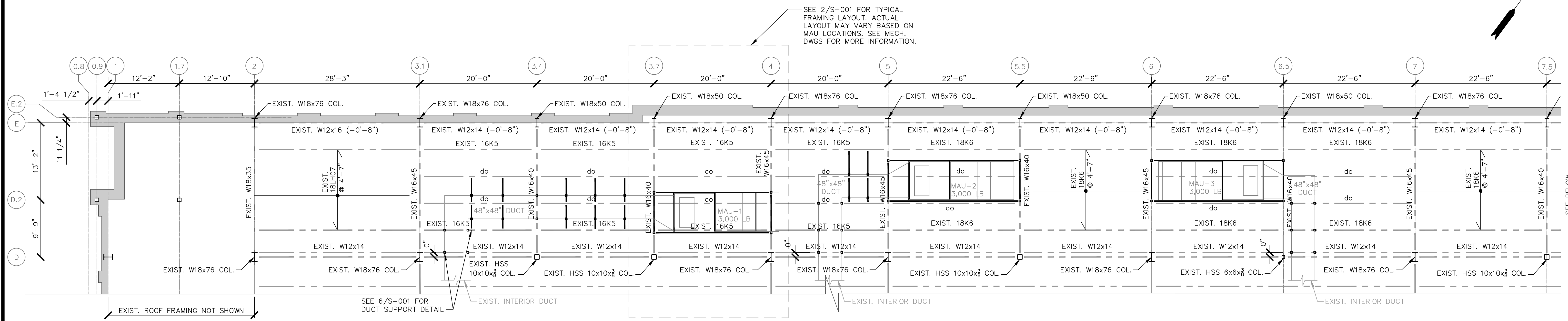
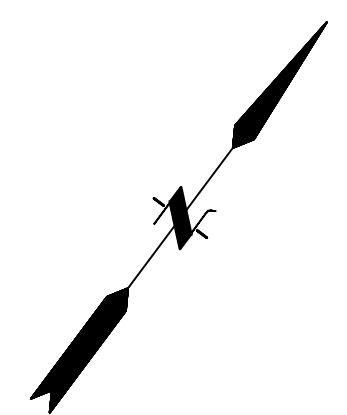
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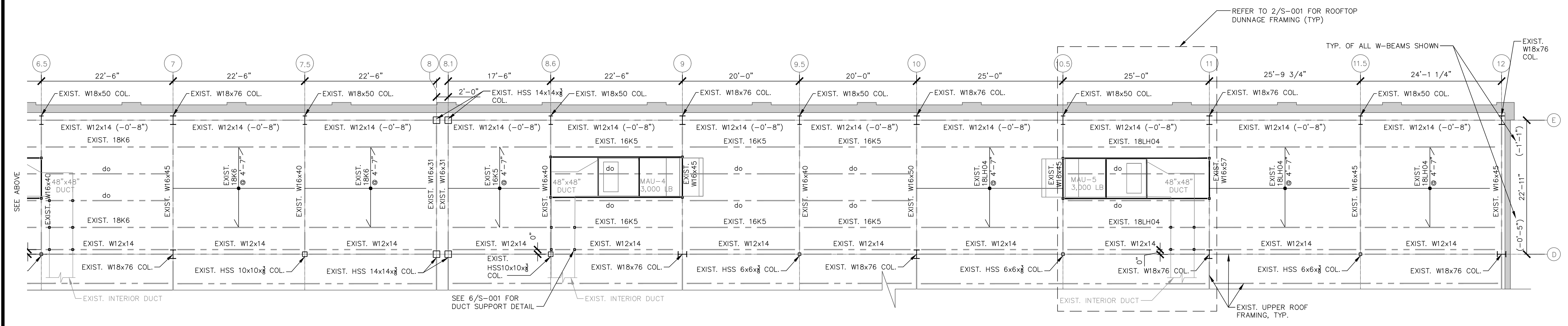
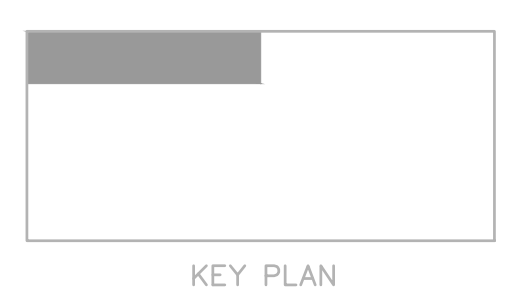
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PARTIAL FIRST FLOOR PLAN B
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE
RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: FEBRUARY 10, 2020
S-101



1 ROOF FRAMING PLAN - PART A
1/8" = 1'-0"
(T.O.S. EL. 116'-0" AT EXTERIOR FACE OF BUILDING)



2 ROOF FRAMING PLAN - PART B
1/8" = 1'-0"
(T.O.S. EL. 116'-0" AT EXTERIOR FACE OF BUILDING)



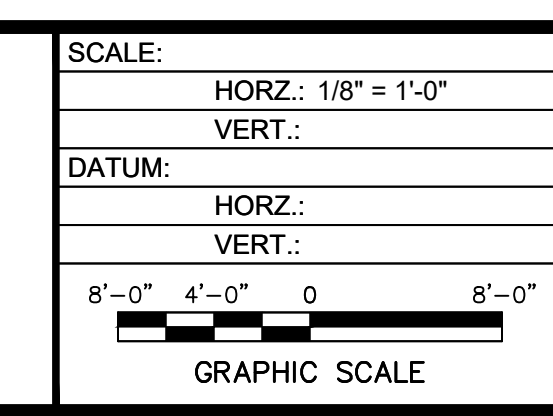
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1.	8/30/2019	100% BID DOCUMENTS	KET	RCB

SEAL

SEAL

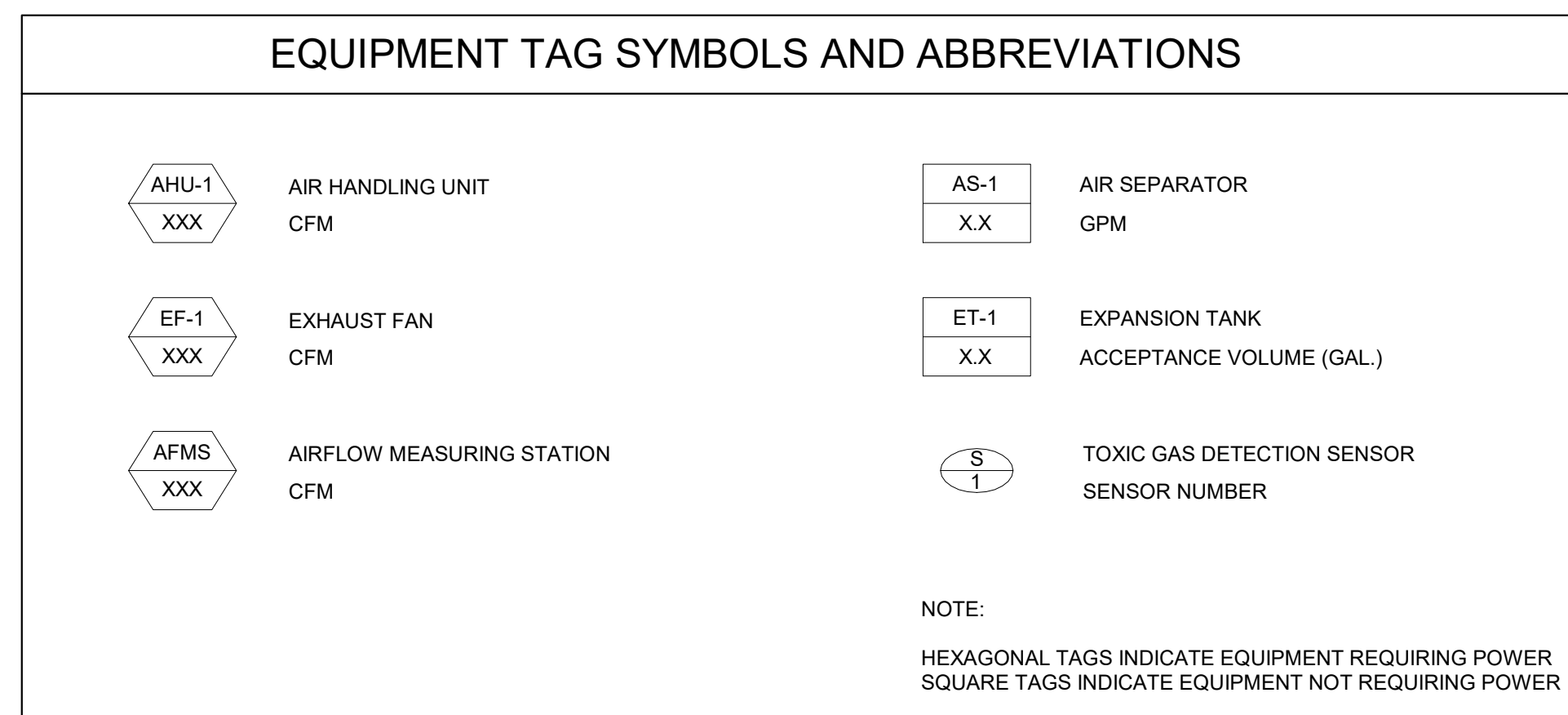
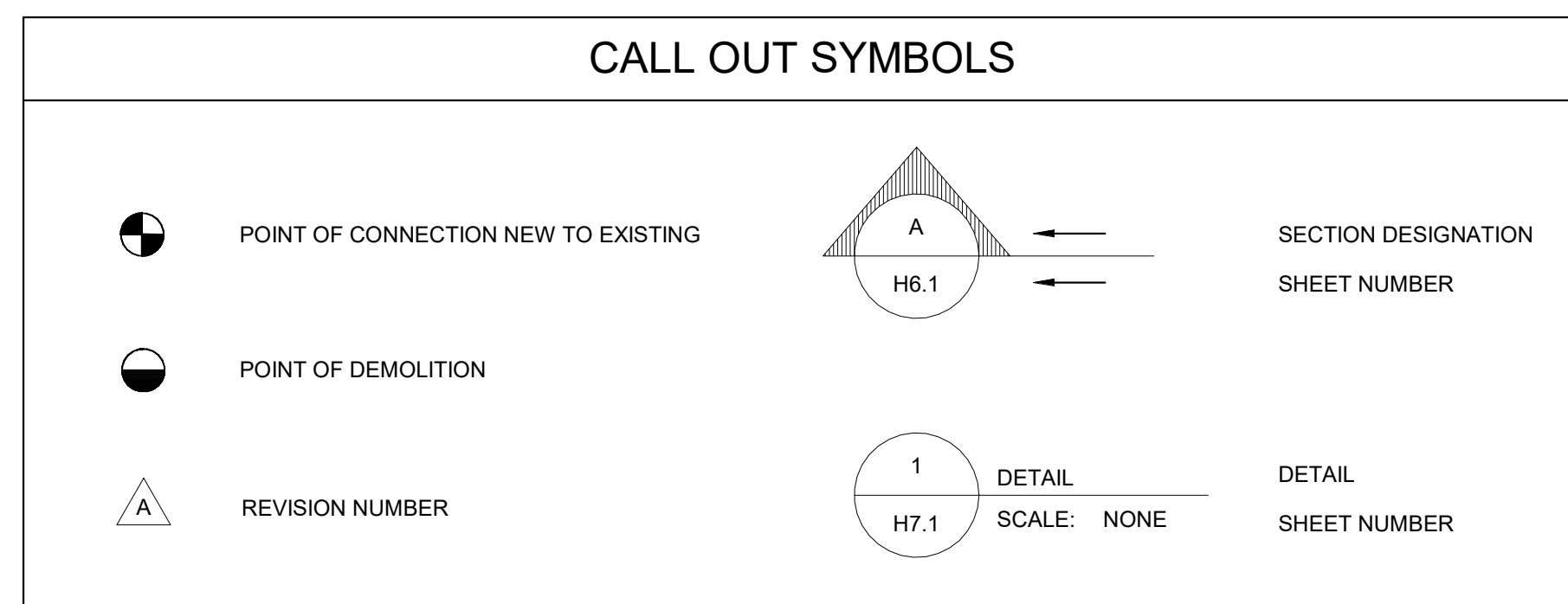


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ROOF FRAMING PLAN
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: FEBRUARY 10, 2020
S-102

Sheet List			
Sheet Name	Sheet Number	Current Revision Description	Current Revision Date
LEGEND SHEET	M-001	ISSUED FOR BID	2-06-20
LEGEND SHEET	M-002	ISSUED FOR BID	2-06-20
MAIN LEVEL - DUCT / PIPING DEMO	M-300	ISSUED FOR BID	2-06-20
ROOF LEVEL - DUCT / PIPING DEMO	M-301	ISSUED FOR BID	2-06-20
MAIN LEVEL - DUCT / PIPING EAST	M-400	ISSUED FOR BID	2-06-20
MAIN LEVEL - DUCT / PIPING WEST	M-400A	ISSUED FOR BID	2-06-20
ROOF LEVEL - DUCT / PIPING	M-401	ISSUED FOR BID	2-06-20
SECTIONS & ISOMETRIC VIEWS	M-600	ISSUED FOR BID	2-06-20
DETAILS	M-700	ISSUED FOR BID	2-06-20
DETAILS	M-701	ISSUED FOR BID	2-06-20
MECHANICAL EQUIPMENT SCHEDULE	M-800	ISSUED FOR BID	2-06-20
MAU CONTROL DIAGRAM	M-900	ISSUED FOR BID	2-06-20
BAS NETWORK DIAGRAM & SEQUENCES	M-901	ISSUED FOR BID	2-06-20
NATURAL GAS PIPING LAYOUT	P-100	ISSUED FOR BID	2-06-20
BUILDING NATURAL GAS FLOW DIAGRAM	P-101	ISSUED FOR BID	2-06-20



ABBREVIATIONS	
ABV.	ABOVE
AC	AIR CONDITIONER
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
AL	ACOUSTICAL LINING
ALD	AUTOMATIC LOUVER DAMPER (MOTORIZED)
ATC	AUTOMATIC TEMPERATURE CONTROL
B.D.D.	BACK DRAFT DAMPER
BMS	BUILDING MANAGEMENT SYSTEM
BOD	BOTTOM OF DUCT
B.H.P.	BRAKE HORSE POWER
B.R.D.	BAROMETRIC RELIEF DAMPER
BTU	BRITISH THERMAL UNIT
CC	COOLING COIL
CD	CEILING DIFFUSER
CFM	CUBIC FEET PER MINUTE
C.G.	CEILING GRILLE
CHW	CHILLED WATER
C.O.	CLEAN OUT
COD	CABLE OPERATED VOLUME DAMPER
CDP	CONDENSATE DRAIN PIPING
DN	DOWN
E.A.T.	ENTERING AIR TEMPERATURE
EF	EXHAUST FAN
EHC	ELECTRIC HEATING COIL
EV	EXPANSION VESSEL/EXPANSION TANK
E.W.T.	ENTERING WATER TEMPERATURE
FC	FLEXIBLE CONNECTION
FCU	FAN COIL UNIT
FD/AD	FIRE DAMPER/ACCESS DOOR
FD/GA	FIRE DAMPER/GRILLE ACCESS
FL	FLOOR
F.L.A.	FULL LOAD AMPS
FSD	FIRE SMOKE DAMPER
FSD/AD	FIRE SMOKE DAMPER/ACCESS DOOR
FSD/GA	FIRE SMOKE DAMPER/GRILLE ACCESS
GPM	GALLONS PER MINUTE
GX	GENERAL EXHAUST
HC	HEATING COIL
HHW	HEATING HOT WATER
HP	HORSE POWER
HX	HEAT EXCHANGER (SHELL & TUBE)
I.D.	INSIDE DIMENSION
KW	KILOWATT
L.A.T.	LEAVING AIR TEMPERATURE
LED	LINEAR EXHAUST DIFFUSER (CEILING, WALL, SILL, OR FLOOR)
LRD	LINEAR RETURN DIFFUSER (CEILING, WALL, SILL, OR FLOOR)
LSD	LINEAR SUPPLY DIFFUSER (CEILING, WALL, SILL, OR FLOOR)
LTHW	LOW TEMPERATURE HOT WATER
LVL	LEVEL
LWS	LOUVER WITH WIRE SCREEN
L.W.T.	LEAVING WATER TEMPERATURE
M.A.T.	MIXED AIR TEMPERATURE
MAX	MAXIMUM
MBH	THOUSAND BTU PER HOUR
MIN.	MINIMUM
MO (WO)	MASONRY OPENING (WALL OPENING)
N.C.	NORMALLY CLOSED
NFA	NET FREE AREA
N.I.C.	NOT IN THIS CONTRACT
N.O.	NORMALLY OPEN
N.T.S.	NOT TO SCALE
OA	OUTSIDE AIR
OAT	OUTSIDE AIR TEMPERATURE
OBD	OPPOSED BLADE DAMPER
OED	OPEN ENDED DUCT
P	PUMP
PHC	PRE-HEAT COIL
PHX	PLATE & FRAME HEAT EXCHANGE
PSI	POUNDS PER SQUARE INCH (GAUGE)
RA	RETURN AIR
RF	RETURN FAN
RHC	REHEAT COIL
RPM	REVOLUTIONS PER MINUTE
RR	RETURN REGISTER
RX	RECYCLING ROOM EXHAUST
SA	SUPPLY AIR
SCHW	SECONDARY CHILLED WATER
SD	SMOKE DAMPER
SD/ALD	SMOKE DAMPER AND AUTOMATIC LOUVER COMBINATION
SF	SUPPLY FAN
SG	SUPPLY GRILLE
ST	SOUND TRAP
SX	SMOKE EXHAUST
TOD	TOP OF DUCT
TF	TRANSFER FAN
T.G.	TOP GRILLE
T.R.	TOP REGISTER
TR.D.	TRANSFER DUCT
TRX	TRASH EXHAUST
TX	TOILET EXHAUST
UH	UNIT HEATER
VAV	VARIABLE AIR VOLUME
VD	VOLUME DAMPER
WMS	WIRE MESH SCREEN
(300)	CUBIC FEET OF AIR PER MINUTE OR GALLONS PER MINUTE

ISSUED FOR BID

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL

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SCALE: 12" = 1'-0"

DATUM:

GRAPHIC SCALE

NTS



RHODE ISLAND PUBLIC TRANSIT AUTHORITY

LEGEND SHEET

750 ELMWOOD AVE - BUS LIFT REPLACEMENT

PROVIDENCE

RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019

M-001

SINGLE LINE PIPING SYMBOLS (PLANS & UFD'S)	
WATER SYSTEMS	
	PRESSURE REDUCING VALVE
	BACKFLOW PREVENTER
	FULL PORT BALL VALVE (NORMALLY OPEN)
	FULL PORT BALL VALVE (NORMALLY CLOSED)
	CIRCUIT SETTER (SIZE FOR FLOW RATE)
	CHECK VALVE
	BUTTERFLY VALVE (LUG TYPE)
	MOTORIZED BUTTERFLY VALVE
	ECCENTRIC REDUCER (CONCENTRIC)
	ECCENTRIC REDUCER (FLAT ON TOP)
	DRAIN BALL VALVE WITH HOSE END CONNECTION WITH CAP & CHAIN
	GATE VALVE
	GLOBE VALVE (NC)
	GLOBE VALVE (NO)
	TWO-WAY CONTROL VALVE (ELECTRIC ACTUATED)
	TWO-WAY CONTROL VALVE (PNEUMATIC ACTUATED)
	THREE-WAY CONTROL VALVE (ELECTRIC ACTUATED)
	BLIND FLANGE
	END CAP
	UNION OR FLANGE
	DRAIN "P" TRAP
	TAKEOFF UP
	TAKEOFF DOWN
	STEAM TRAP
	WATER FILTER
	PITCH PIPE UP IN DIRECTION OF FLOW
	PITCH PIPE DOWN IN DIRECTION OF FLOW
	FLEX CONNECTOR
	DIRECTION OF FLOW IN PIPE
	CHILLED WATER SUPPLY
	CHILLED WATER RETURN
	COOLING TOWER WATER SUPPLY
	COOLING TOWER WATER RETURN
	CONDENSATE DRAIN
	NON POTABLE COLD WATER
	POTABLE COLD WATER
	HOT WATER SUPPLY
	HOT WATER RETURN
	HEAT RECOVERY SUPPLY (GLYCOL)
	HEAT RECOVERY RETURN (GLYCOL)
	"Y" STRAINER
	"Y" STRAINER WITH DRAW OFF BALL VALVE & CAP.

SINGLE LINE PIPING SYMBOLS (PLANS & UFD'S)	
WATER SYSTEMS	
	PRESSURE RELIEF VALVE (SEE UTILITY FLOW DIAGRAM FOR SIZE & SETPOINT)
	FLOOR DRAIN
	AUTOMATIC AIR VENT WITH ISOLATION VALVE
	MANUAL AIR VENT
	DIELECTRIC NIPPLE (USE BETWEEN ALL COPPER, BRASS & STEEL CONNECTIONS)
	ARROW INDICATES DIRECTION OF FLOW
	POINT OF DISCONNECT
	CONNECT NEW TO EXISTING
	EXISTING PIPING, DUCTWORK, EQUIPMENT, ETC..
	NEW PIPING, DUCTWORK, EQUIPMENT, ETC..
	DEMO PIPING, DUCTWORK, EQUIPMENT, ETC..

SINGLE LINE PIPING SYMBOLS (PLANS & UFD'S)	
INSTRUMENTATION	
	PRESSURE GAUGE WITH ISOLATION BALL VALVE (SEE SPECS FOR TYPE) (PROVIDE DIELECTRIC NIPPLE FOR CONNECTION INTO STEEL PIPING)
	TEMPERATURE ELEMENT
	TEMPERATURE INDICATOR (SEE SPECS FOR TYPE) (PROVIDE STAINLESS STEEL THERMOMETER WELL)
	TEMPERATURE TRANSMITTER (PROVIDE STAINLESS STEEL THERMOMETER WELL)
	FLOW METER WITH FLOW TRANSMITTER
	FLOAT SWITCH
	DIFFERENTIAL PRESSURE TRANSMITTER (PROVIDE DIELECTRIC NIPPLES FOR CONNECTION INTO STEEL PIPING)
	STEAM PRESSURE GAUGE W/ STEAM SYPHON COIL

DUCTWORK SYMBOLS	
	BAROMETRIC DAMPER
	MOTORIZED DAMPER
	2 HOUR RATED FIRE DAMPER - TYPE "B" OUT OF AIRSTREAM WITH 212 DEG F. FUSIBLE LINK
	VOLUME DAMPER WITH 2" INSULATION STAND-OFFS
	RETURN DUCT DOWN
	RETURN DUCT UP
	EXHAUST DUCT DOWN
	EXHAUST DUCT UP
	SUPPLY DUCT DOWN
	SUPPLY DUCT UP
	DUCTWORK WITH 1" LINING (NON FIBERGLASS)
	FLEX DUCT
	90° ELBOW WITH DOUBLE WIDTH TURNING VANES
	FLEXIBLE DUCT CONNECTION
	RETURN GRILLE
	EXHAUST GRILLE
	SUPPLY GRILLE
	4-WAY DIFFUSER
	3-WAY DIFFUSER
	2-WAY OPPOSITE DIFFUSER
	2-WAY CORNER DIFFUSER
	1-WAY DIFFUSER
	DUCT MOUNTED SMOKE DETECTOR

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Revision Schedule				
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2	2-06-20	ISSUED FOR BID	MGB	TAE

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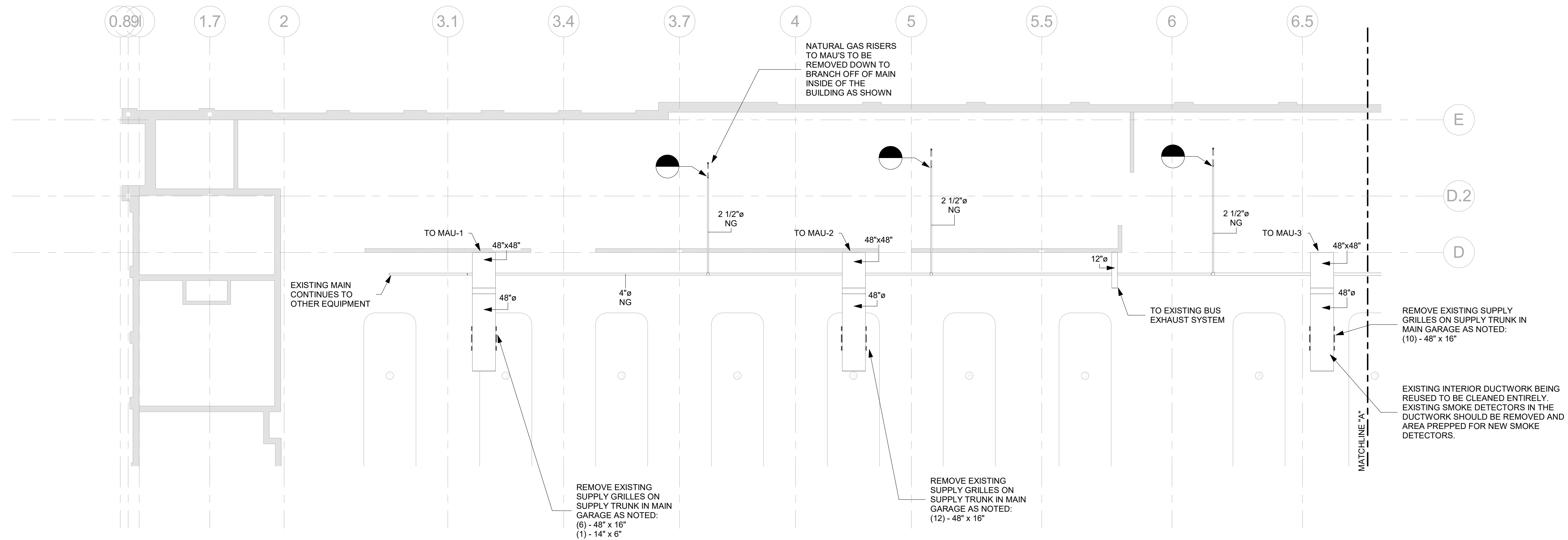


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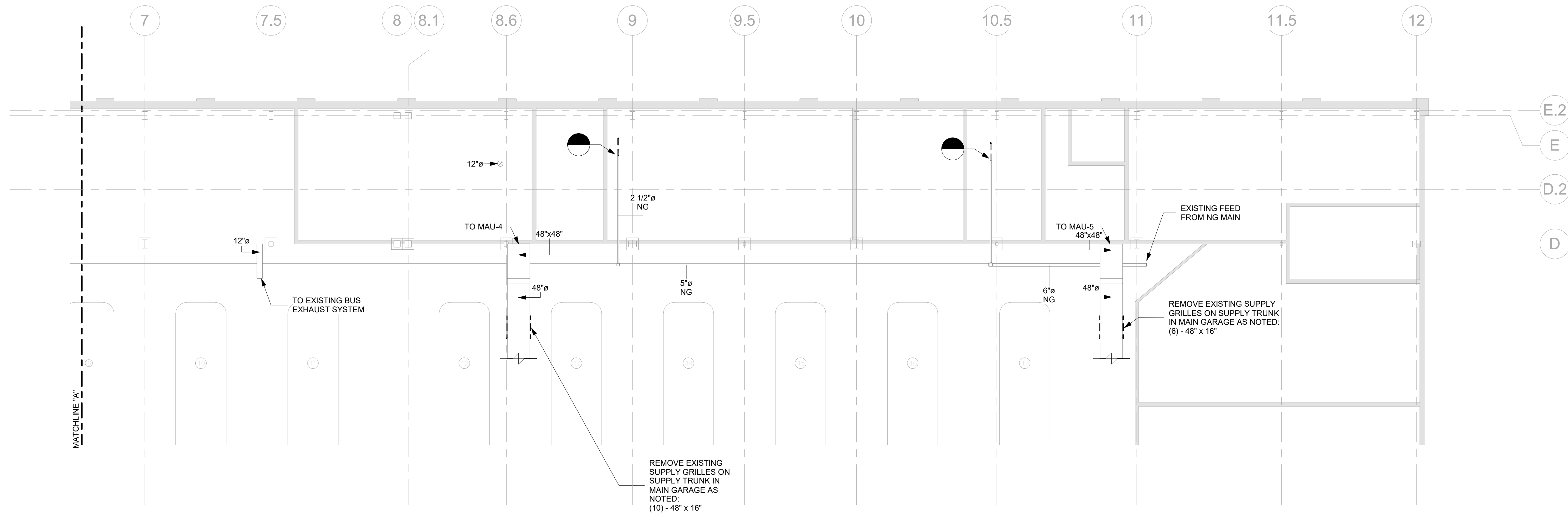
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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
LEGEND SHEET
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20 DATE: AUGUST 30, 2019
M-002



1 - Mech Demo - East
3/32" = 1'-0"



1 - Mech Demo - West
3/32" = 1'-0"

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
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2	2-06-20	ISSUED FOR BID	MGB	TAE

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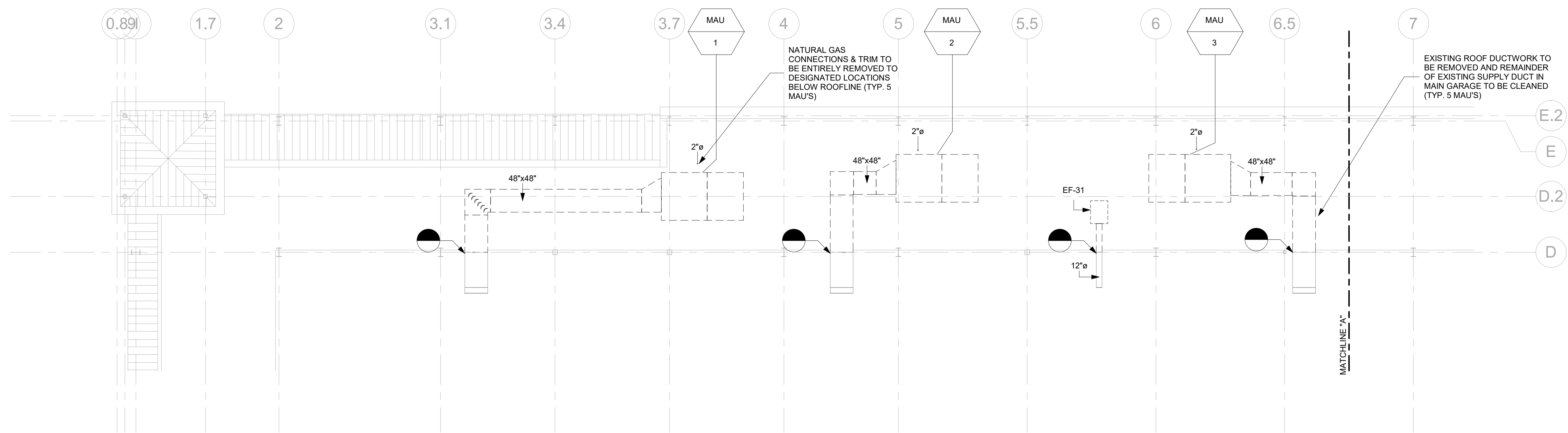


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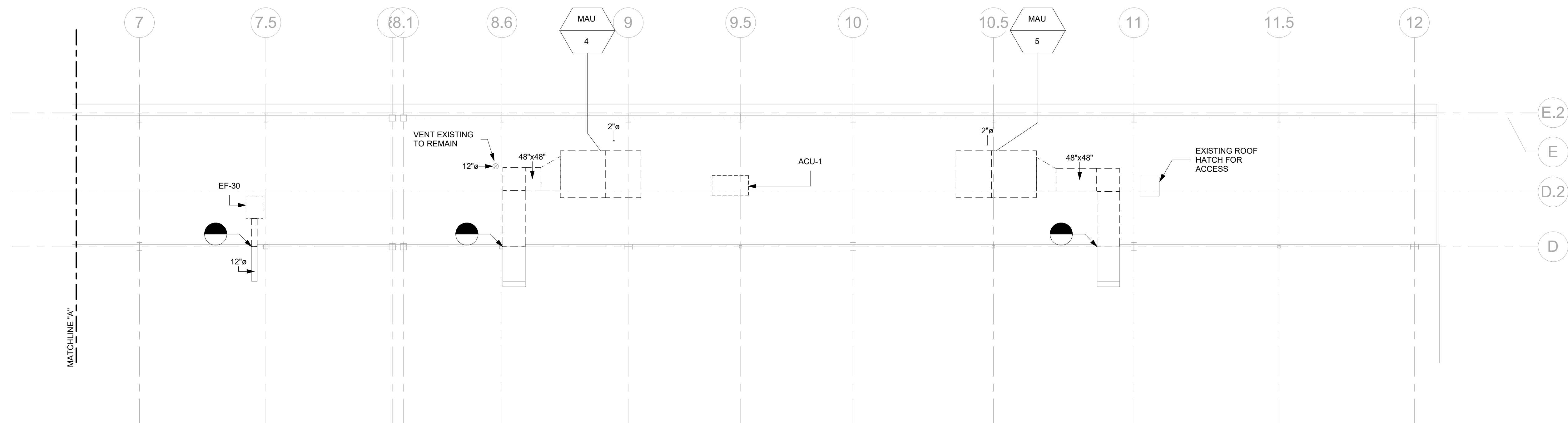
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MAIN LEVEL - DUCT / PIPING DEMO
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
M-300



2 - Mech Demo - East
3/32" = 1'-0"



2 - Mech Demo - West
3/32" = 1'-0"

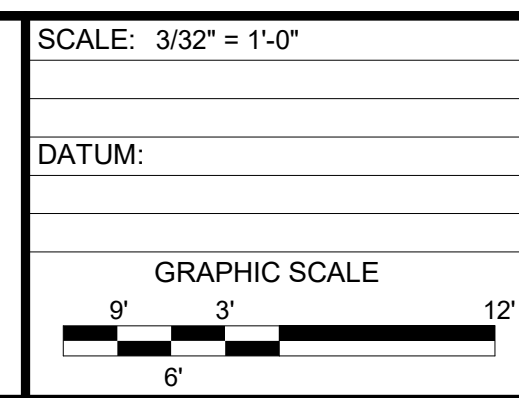
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2	2-06-20	ISSUED FOR BID	MGB TAE

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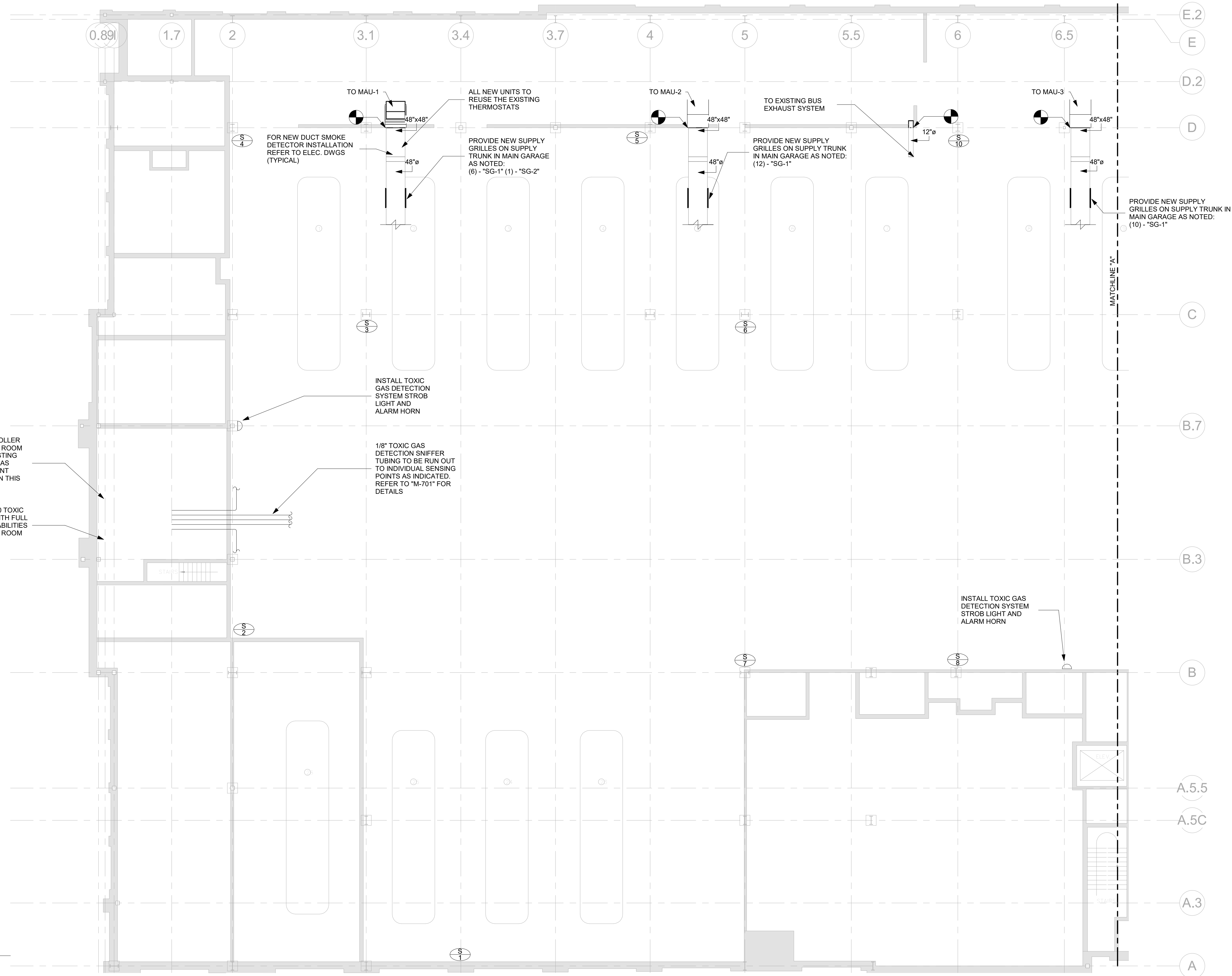
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ROOF LEVEL - DUCT / PIPING DEMO
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

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DATE: AUGUST 30, 2019
M-301

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1 - Mech - East
3/32" = 1'-0"

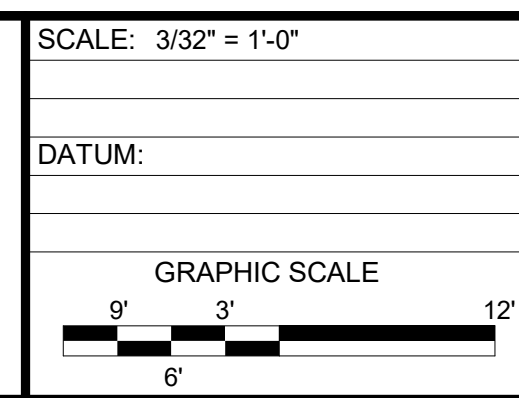


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2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL

SEAL



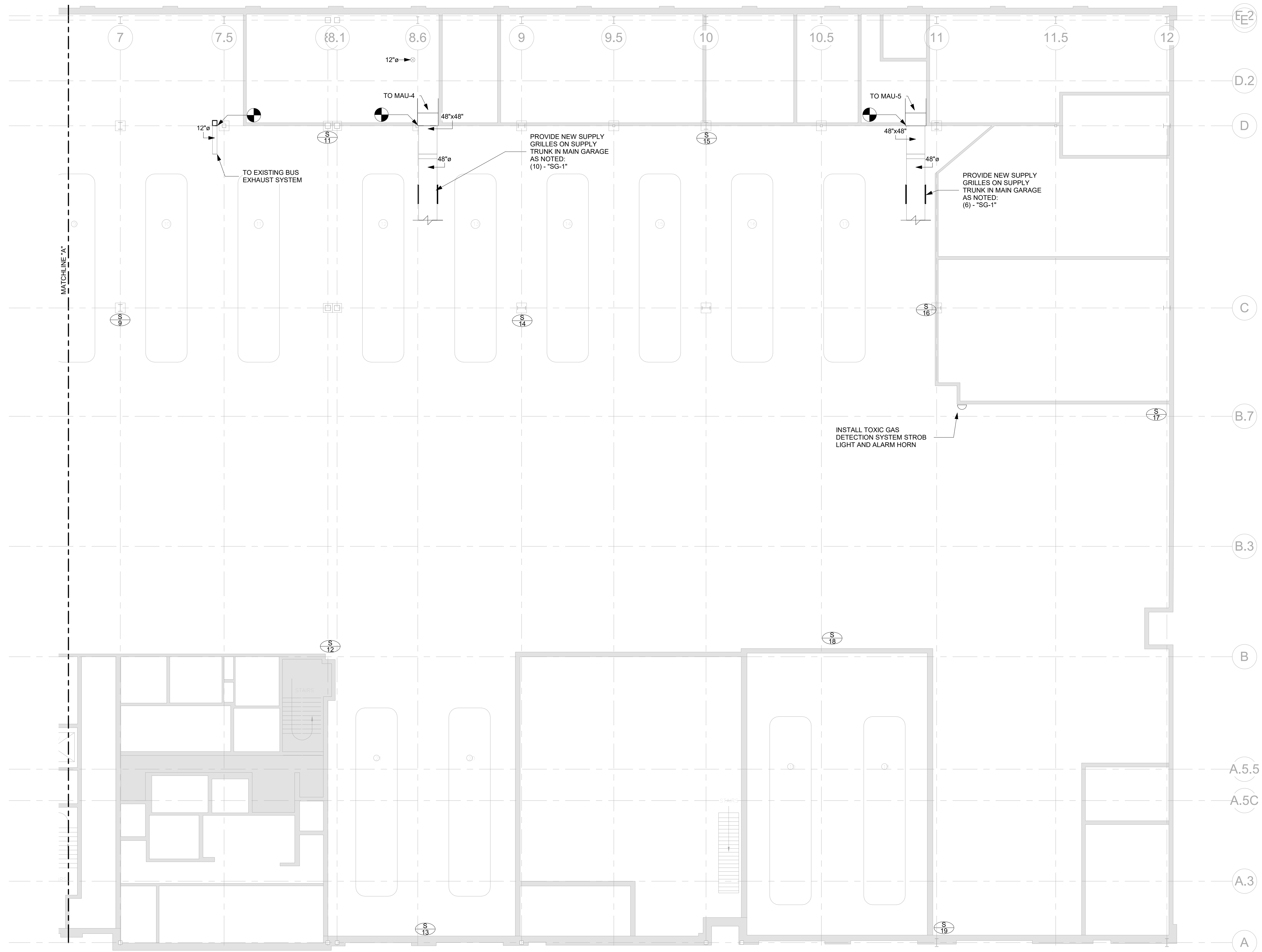
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MAIN LEVEL - DUCT / PIPING EAST
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PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019

M-400

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1 - Mech - West
3/32" = 1'-0"

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Revision Schedule			DESIGNER REVIEWER	
No.	DATE	DESCRIPTION	MGB	TAE
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL

SEAL



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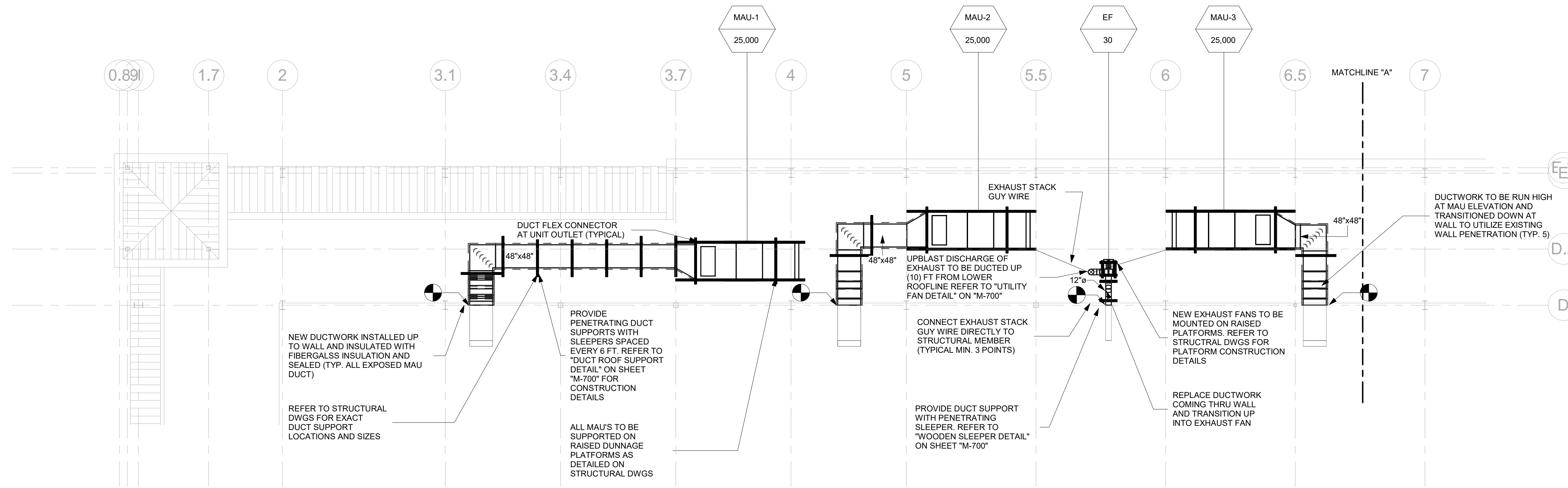
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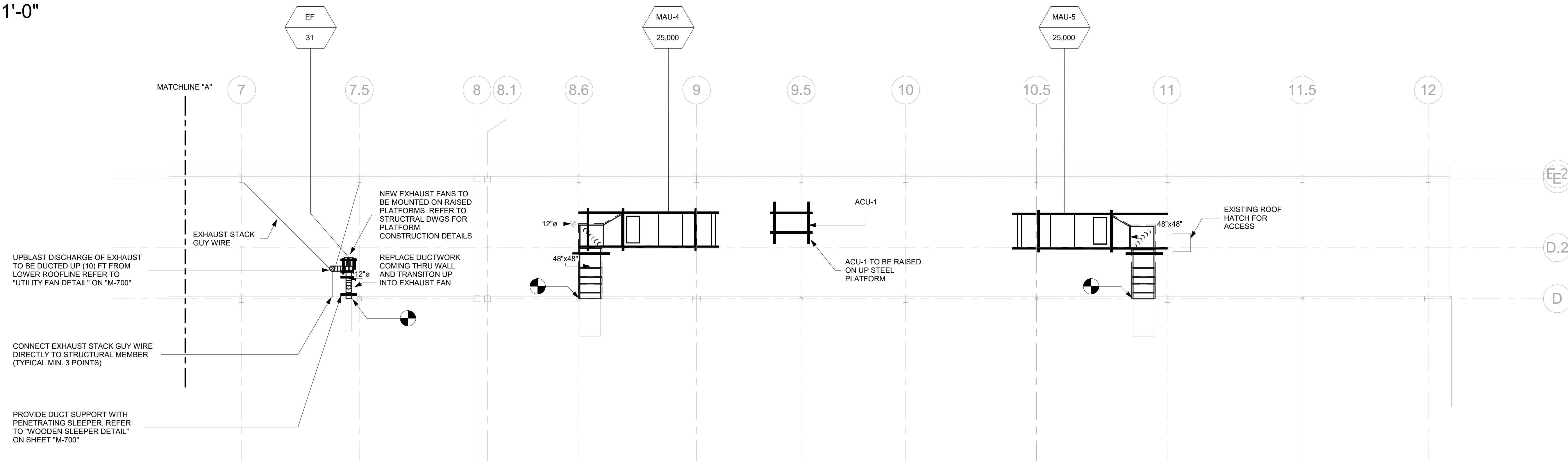


RHODE ISLAND PUBLIC TRANSIT AUTHORITY
MAIN LEVEL - DUCT / PIPING WEST
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
M-400A



2 - Mech - East
3/32" = 1'-0"



2 - Mech - West
3/32" = 1'-0"

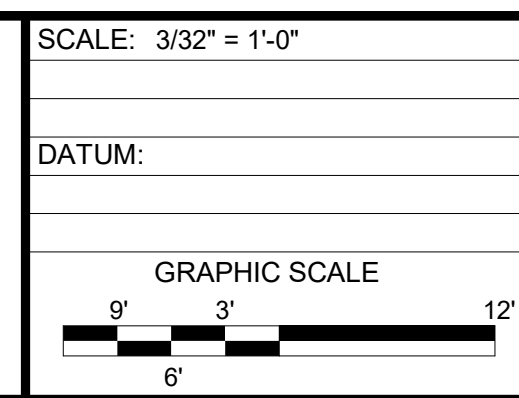
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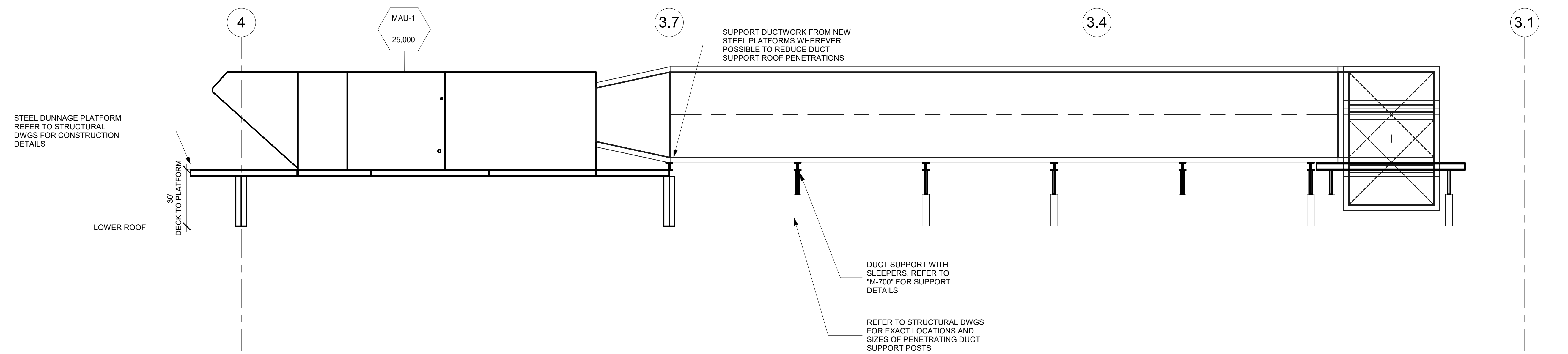
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SEAL

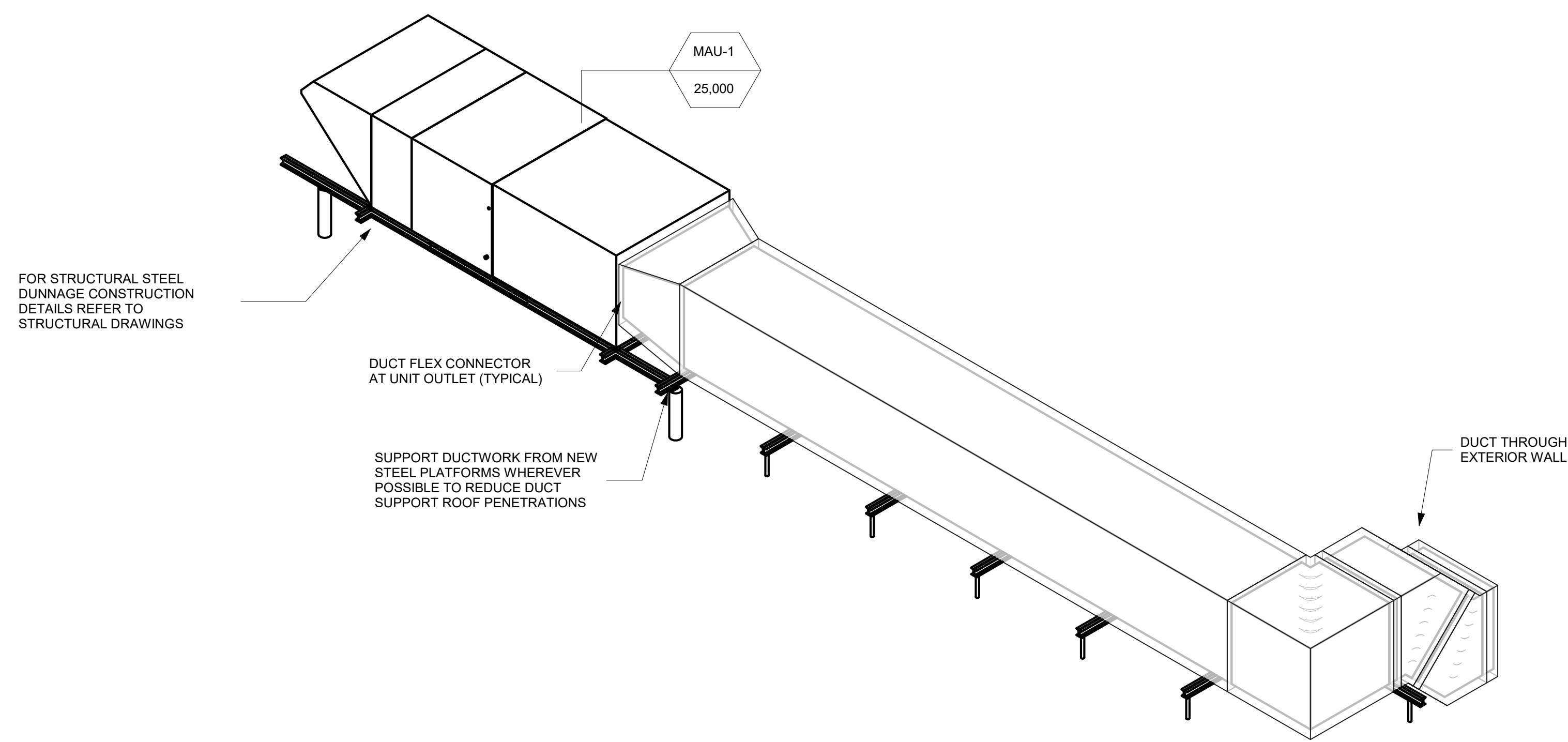


RHODE ISLAND PUBLIC TRANSIT AUTHORITY
ROOF LEVEL - DUCT / PIPING
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

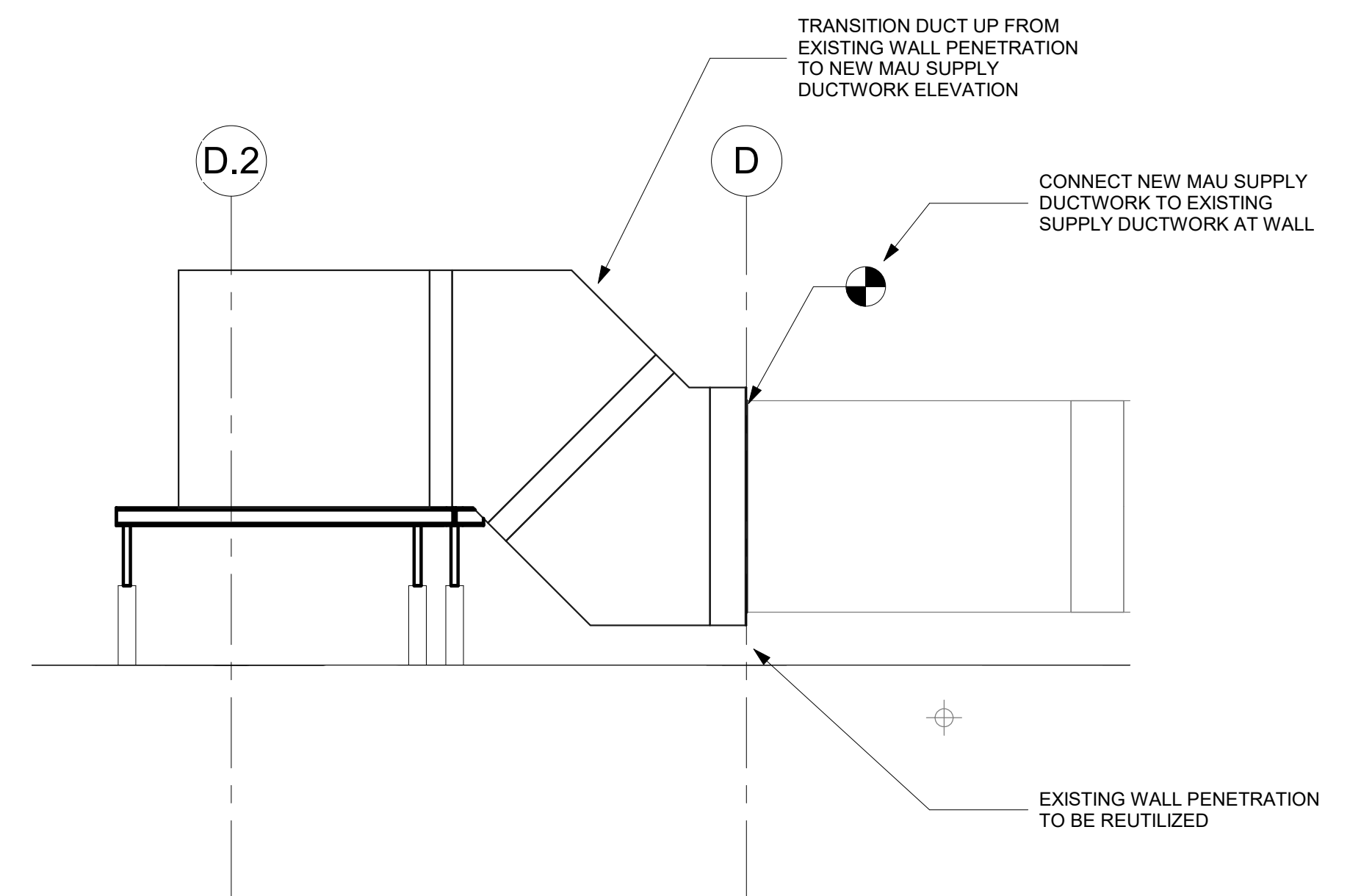
PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
M-401



MAU PROFILE
3/8" = 1'-0"



MAU ISO VIEW



DUCT TRANSITION PROFILE
3/8" = 1'-0"

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL

SEAL



SCALE: 3/8" = 1'-0"

DATUM:

GRAPHIC SCALE

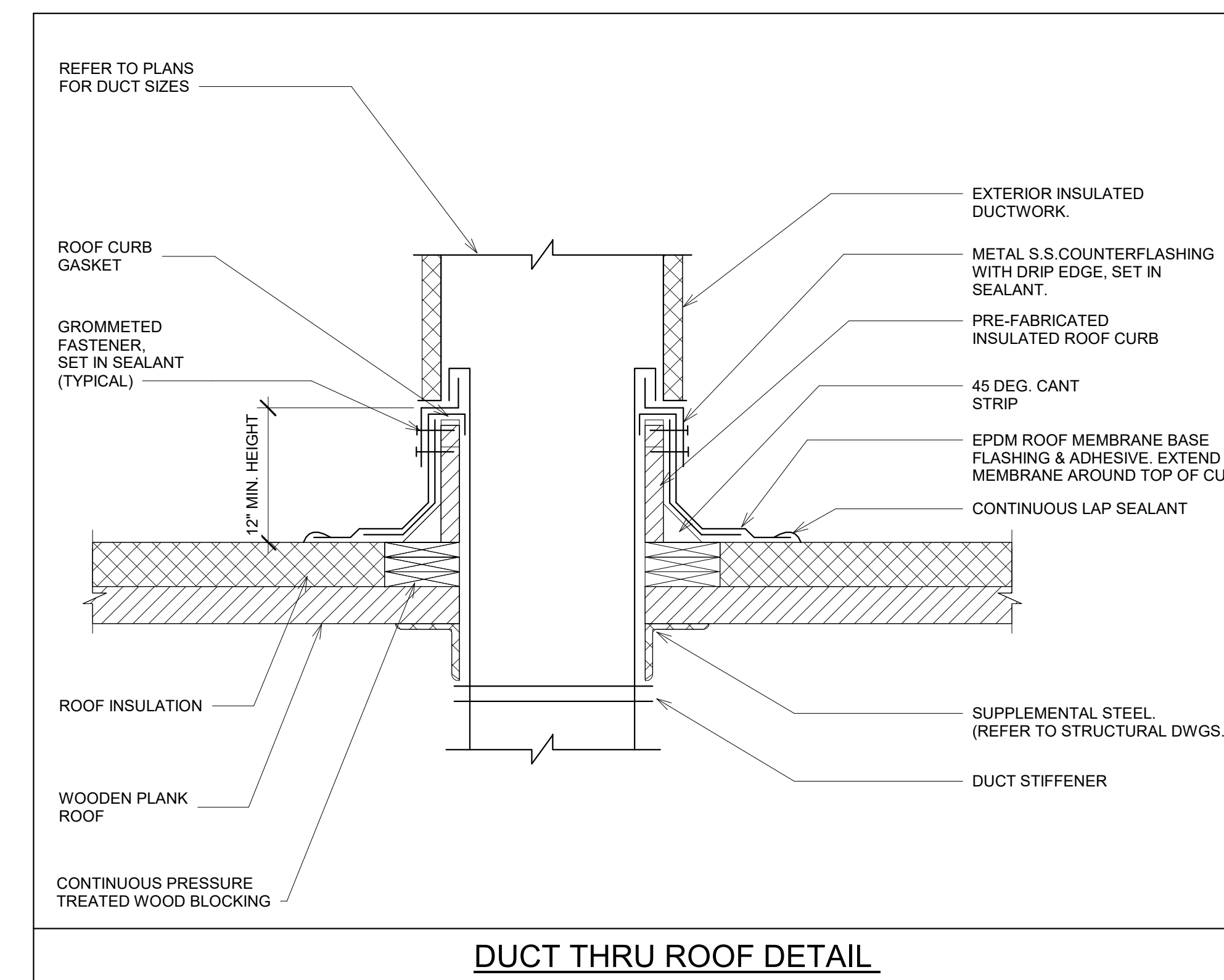
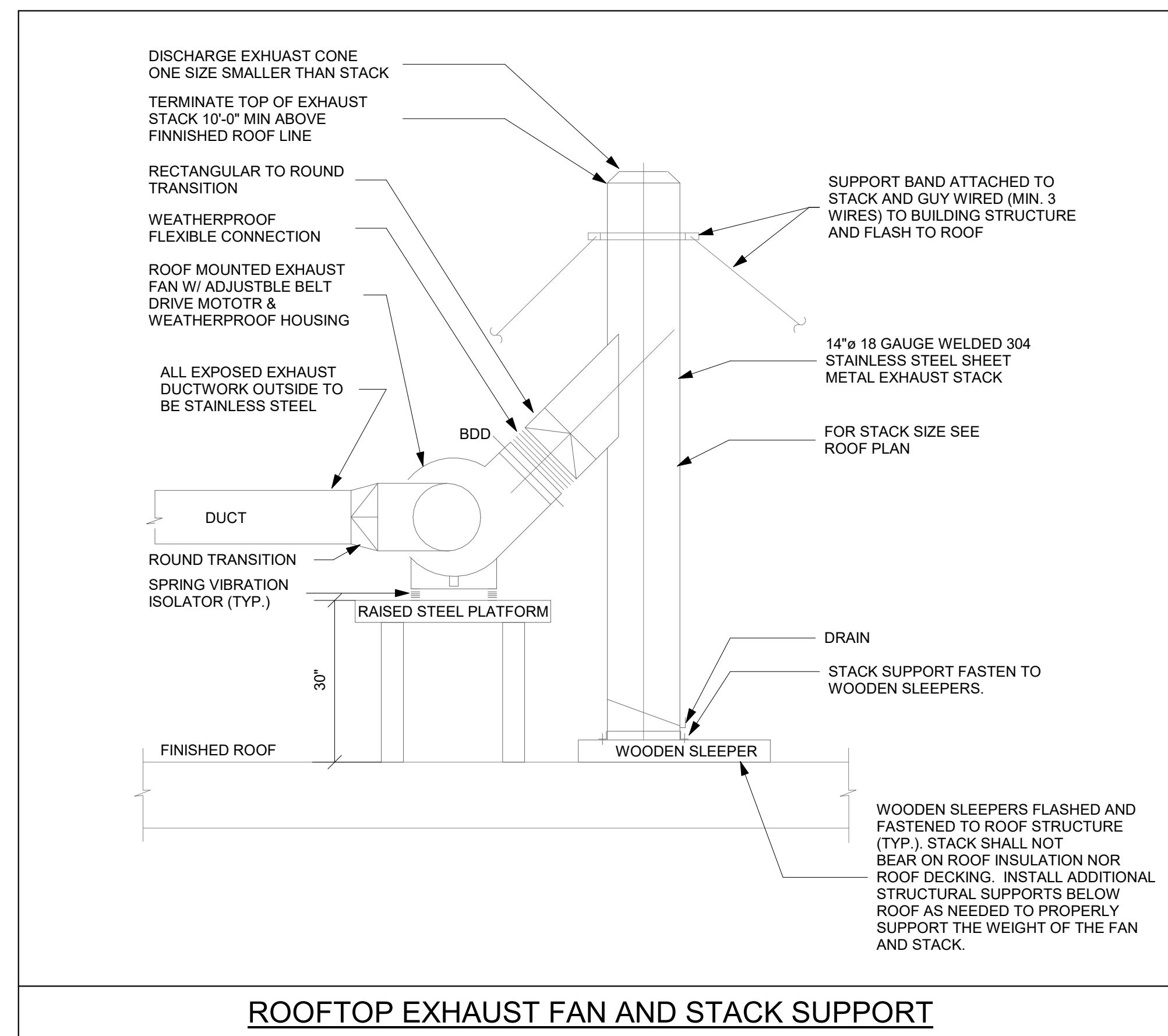
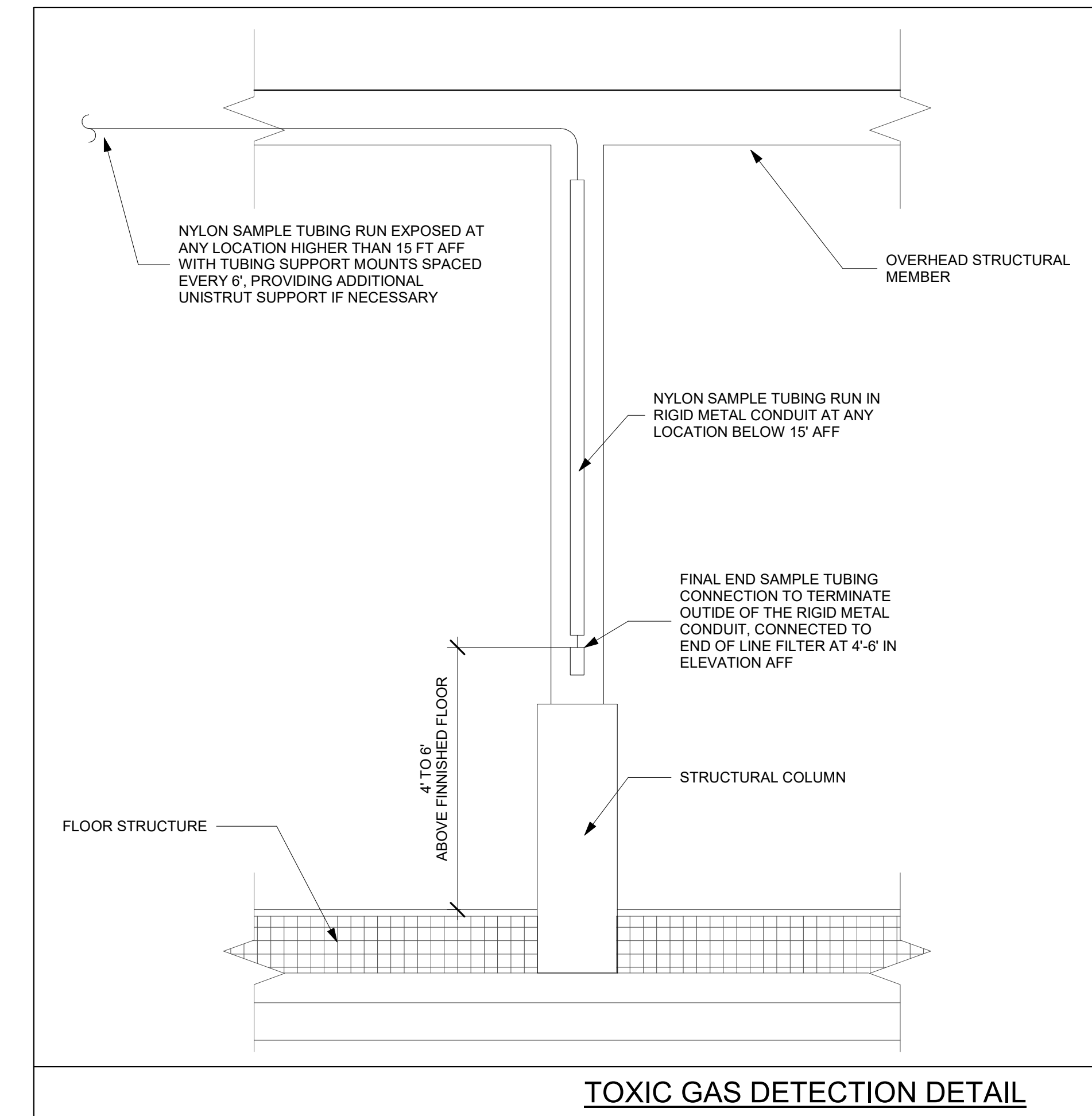
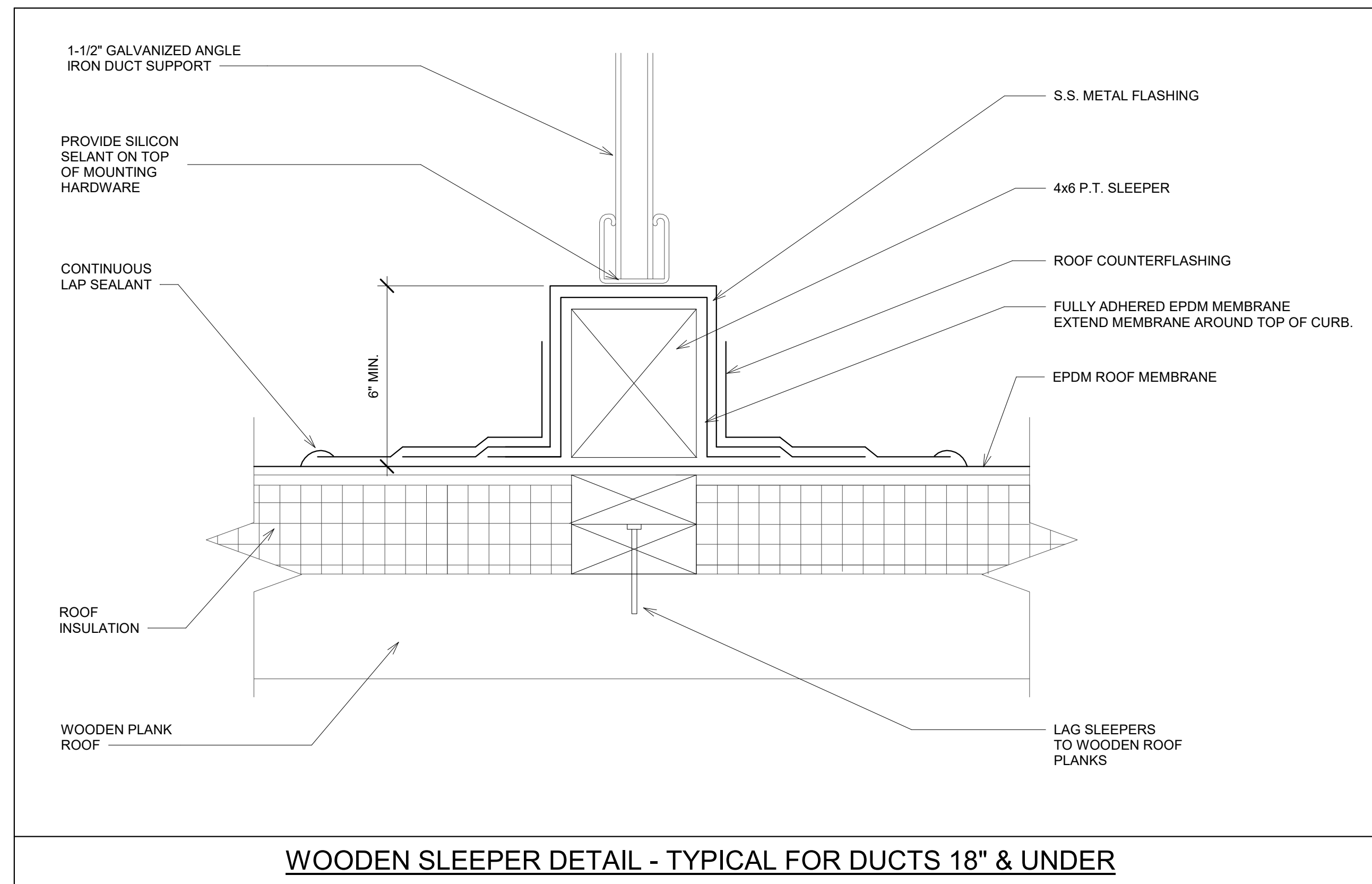
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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
SECTIONS & ISOMETRIC VIEWS
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019

M-600



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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

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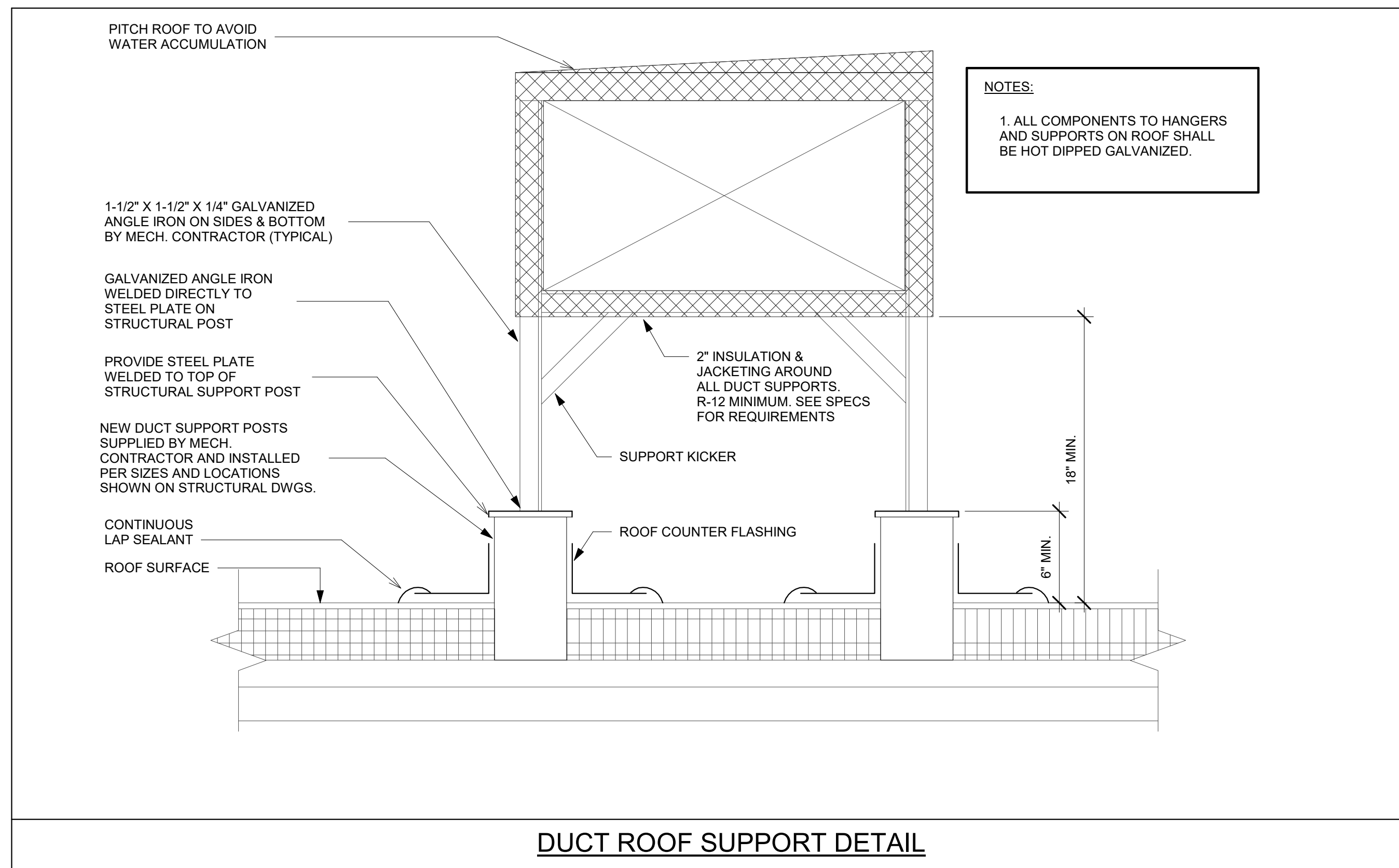


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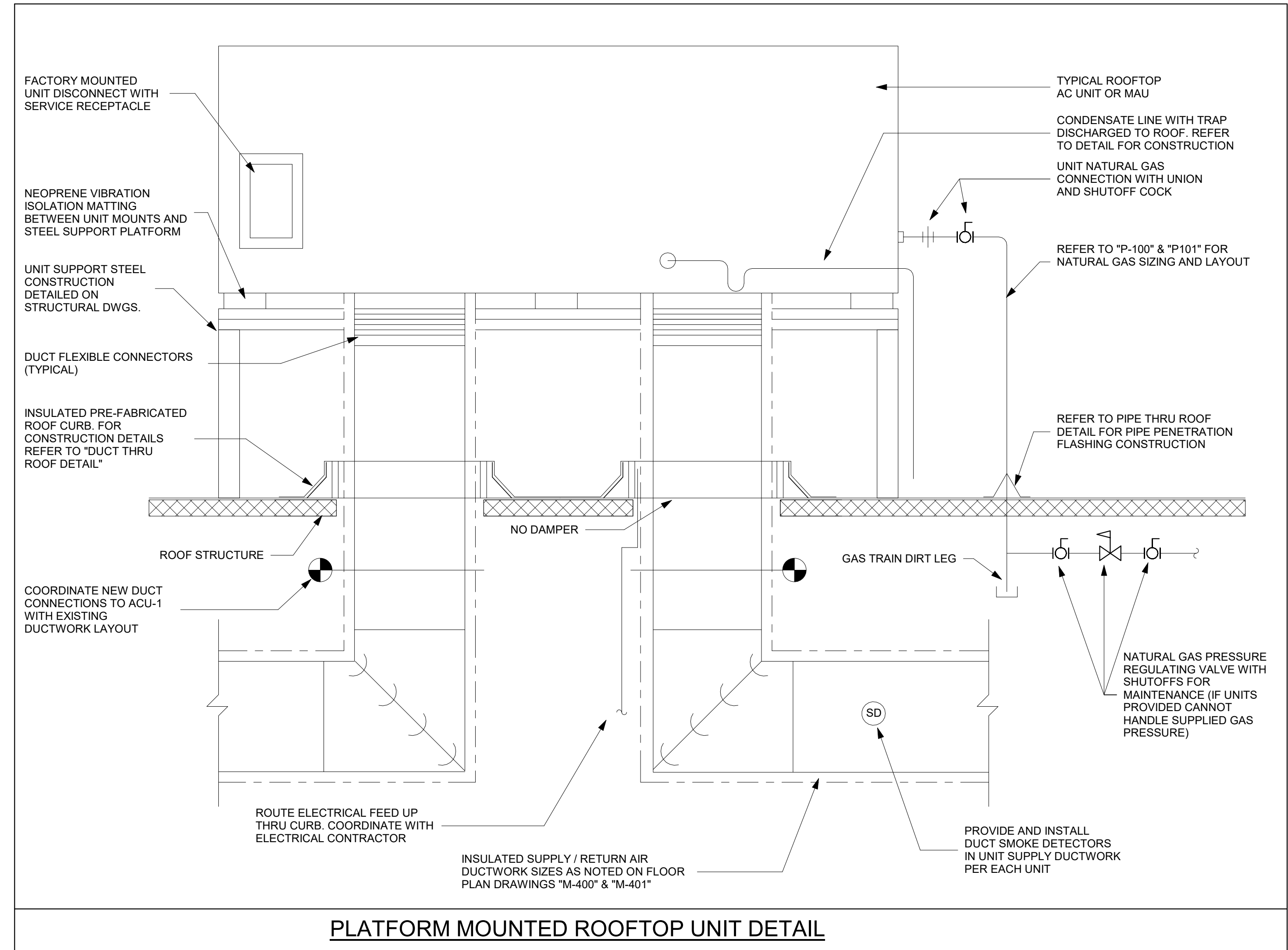


RHODE ISLAND PUBLIC TRANSIT AUTHORITY	
DETAILS	
750 ELMWOOD AVE - BUS LIFT REPLACEMENT	
PROVIDENCE	RHODE ISLAND

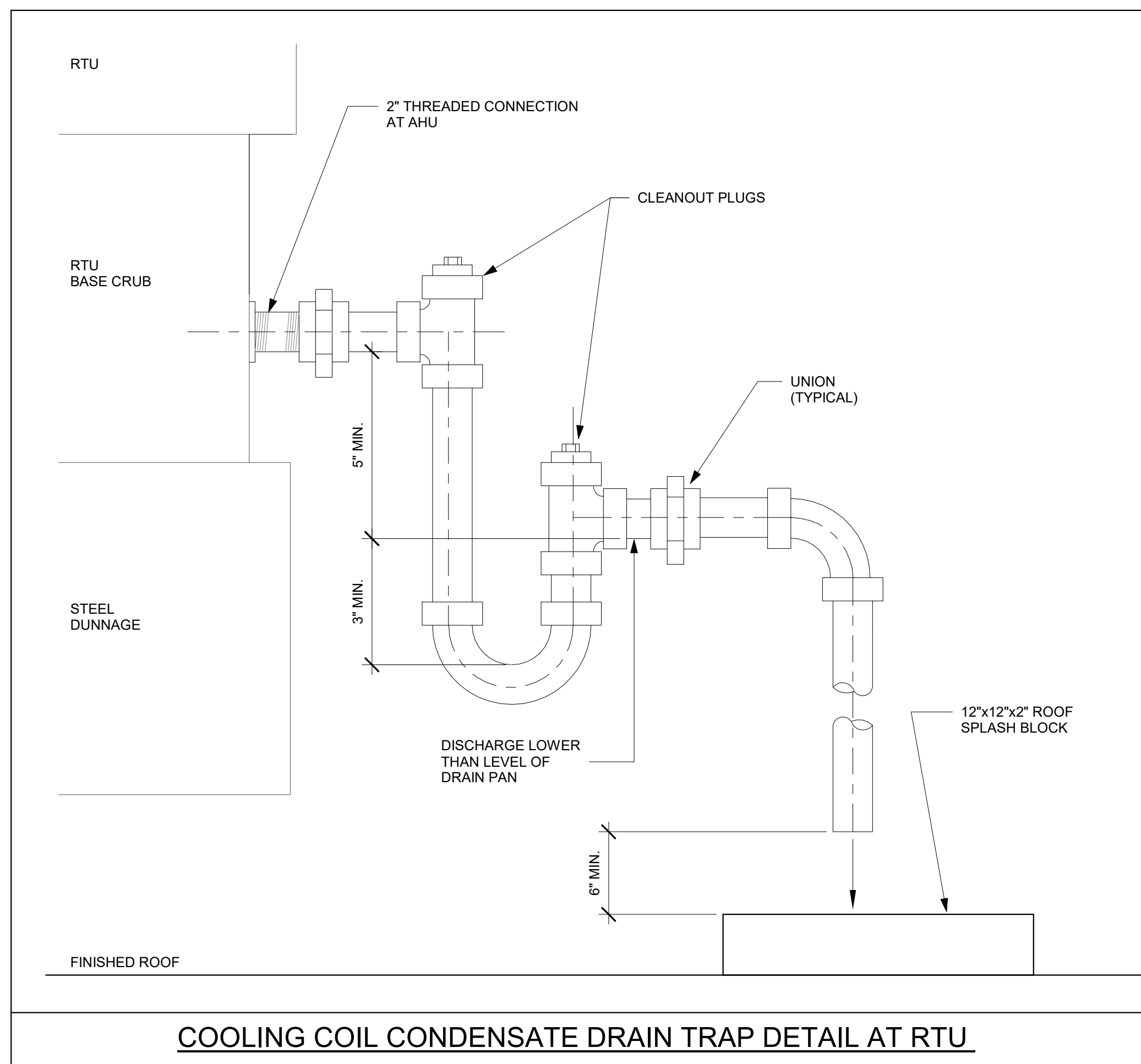
PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
M-700



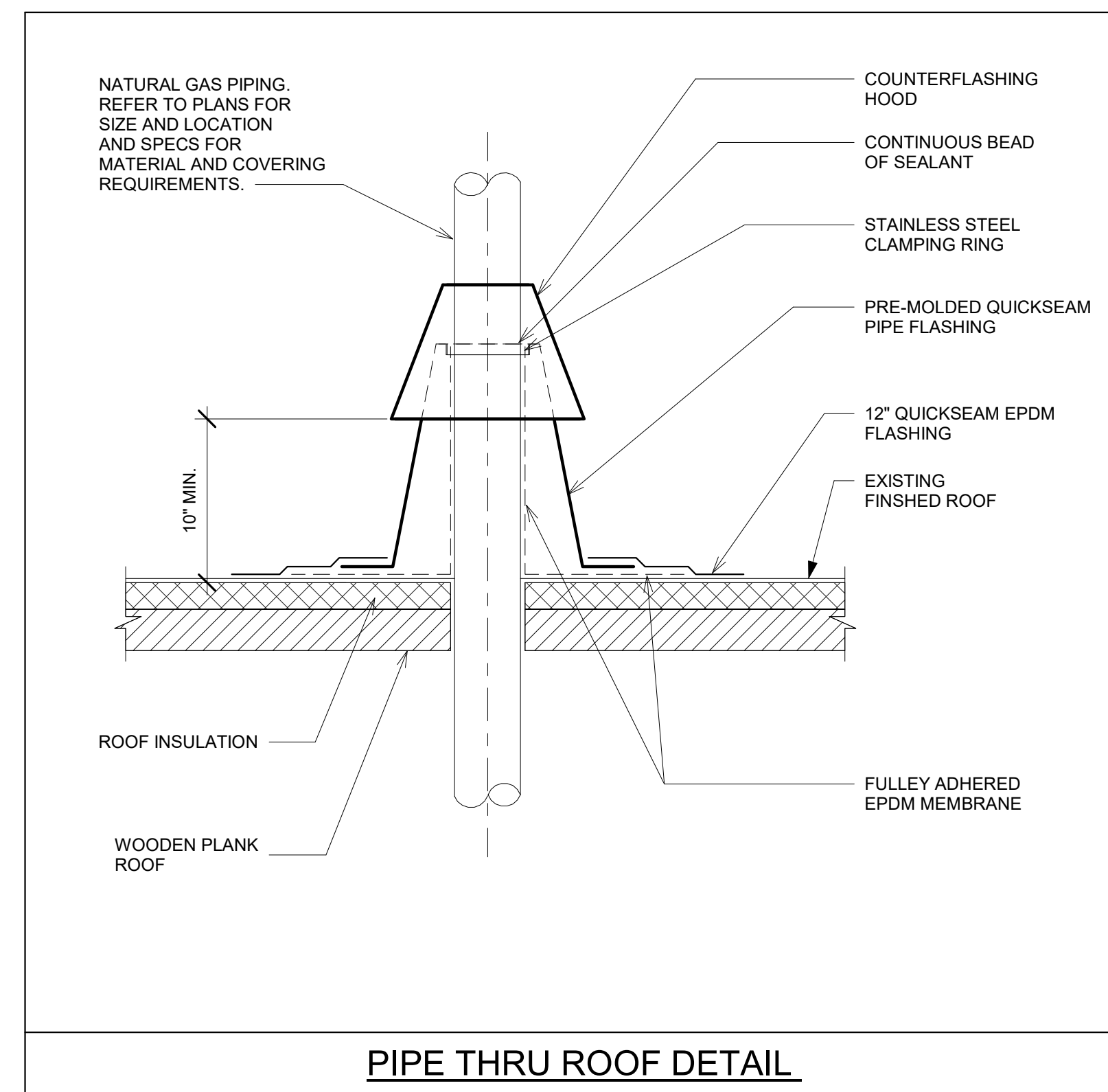
DUCT ROOF SUPPORT DETAIL



PLATFORM MOUNTED ROOFTOP UNIT DETAIL



COOLING COIL CONDENSATE DRAIN TRAP DETAIL AT RTU



PIPE THRU ROOF DETAIL

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL	SEAL
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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 DETAILS
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: AUGUST 30, 2019
M-701

MAKEUP AIR UNIT SCHEDULE

GENERAL DATA							SUPPLY FAN DATA													GAS FIRED HEATING DATA							REMARKS		
TAG NO.	DESIGN BASIS	MODEL	AREA SERVED	LOCATION	UNIT DIMENSIONS (L x W x H)	UNIT WEIGHT (LBS.)	UNIT CONFIGURATION	DESIGN SUPPLY CFM	MIN. O/A CFM	TOTAL SP (IN. WG)	EXT. SP (IN. WG)	FAN RPM	DRIVE TYPE	FAN QTY	MOTOR BHP	MOTOR HP (MINIMUM)	POWER V-Ø-HZ	MCA (AMPS)	TYPE OF CONTROL	STARTER TYPE AND RESPONSIBLE CONTRACTOR	QUANTITY OF VFD'S	MBH (INPUT)	MBH (OUTPUT)	MAIN GAS PRESS (IN. WG)	MAX GAS PRESS (PSI)	TEMP. RISE (°F)		E.A.T DB °F	L.A.T DB °F
MAU-1	GREENHECK	DGX	ENGINE REPAIRS	NORTH LOWER ROOF	216 x 79 x 55	2899	VARIABLE VOL.	25,000	25,000	2,919	1.00	2314	DIRECT	2	13.89	20	480v - 3Ø-60	53.4	VARIABLE VOLUME	VFD PROVIDED BY UNIT MANUFACTURER	(1) VFD PER MOTOR	2,201	2,025	14	5	75	5°	80°	(1) (2)
MAU-2	GREENHECK	DGX	ENGINE REPAIRS	NORTH LOWER ROOF	216 x 79 x 55	2899	VARIABLE VOL.	25,000	25,000	2,919	1.00	2314	DIRECT	2	13.89	20	480v - 3Ø-60	53.4	VARIABLE VOLUME	VFD PROVIDED BY UNIT MANUFACTURER	(1) VFD PER MOTOR	2,201	2,025	14	5	75	5°	80°	(1) (2)
MAU-3	GREENHECK	DGX	ENGINE REPAIRS	NORTH LOWER ROOF	216 x 79 x 55	2899	VARIABLE VOL.	25,000	25,000	2,919	1.00	2314	DIRECT	2	13.89	20	480v - 3Ø-60	53.4	VARIABLE VOLUME	VFD PROVIDED BY UNIT MANUFACTURER	(1) VFD PER MOTOR	2,201	2,025	14	5	75	5°	80°	(1) (2)
MAU-4	GREENHECK	DGX	ENGINE REPAIRS	NORTH LOWER ROOF	216 x 79 x 55	2899	VARIABLE VOL.	25,000	25,000	2,919	1.00	2314	DIRECT	2	13.89	20	480v - 3Ø-60	53.4	VARIABLE VOLUME	VFD PROVIDED BY UNIT MANUFACTURER	(1) VFD PER MOTOR	2,201	2,025	14	5	75	5°	80°	(1) (2)
MAU-5	GREENHECK	DGX	ENGINE REPAIRS	NORTH LOWER ROOF	216 x 79 x 55	2899	VARIABLE VOL.	25,000	25,000	2,919	1.00	2314	DIRECT	2	13.89	20	480v - 3Ø-60	53.4	VARIABLE VOLUME	VFD PROVIDED BY UNIT MANUFACTURER	(1) VFD PER MOTOR	2,201	2,025	14	5	75	5°	80°	(1) (2)

- (1) FOR ALL OTHER UNIT CONSTRUCTION REQUIREMENTS, REFERR TO SPECIFICATION 63751-237800
- (2) UNITS SCHEDULED TO BE ABLE TO HANDLE MORE THAN THE SITE VERIFIED 2.0 PSI NG INLESS PRESSURE. ANY ALTERNATE UNIT INSTALLED BY THE MECH. CONTRACTOR MUST BE CAPABLE OF ACCEPTING THE SCHEDULED MAX INLET PSI. IF THE ALTERNATE CANNOT ACCEPT THIS ELEVATED PRESSURE, AN EXTERNAL PRESSURE REDUCING VALVE MUST BE SUPPLIED BY THE MECH. CONTRACTOR. IF AN EXTERNAL PRESSURE REDUCING VALVE IS NECESSARY, IT MUST BE INSTALLED BELOW THE ROOF LINE, OUT OF EXPOSURE TO WEATHER.

EXHAUST FAN SCHEDULE

GENERAL DATA						FAN DATA								ELECTRICAL DATA		TYPE OF CONTROL	REMARKS
TAG NO.	DESIGN BASIS	MODEL NO.	ARRANGEMENT/TYPE	AREA SERVED	LOCATION	OPERATING WEIGHT (LBS.)	FAN CFM (MAX./MIN.)	DESIGN CFM	DESIGN EXT. SP (IN. WG)	FAN RPM	DRIVE TYPE	WHEEL DIA. (IN.)	MOTOR BHP	MOTOR HP (MINIMUM)	POWER V-Ø-HZ		
EF-30	GREENHECK	USF-315-BI	ROOF MOUNTED UTILITY SET FAN	MAIN GARAGE BUS EXHAUST HOSES	NORTH LOWER ROOF	235	2400/2400	2400	4.00	2,325	BELT	15	2.58	3.00	460/3/60	CONSTANT VOLUME WITH SPEED CONTROLLER	(1)
EF-31	GREENHECK	USF-315-BI	ROOF MOUNTED UTILITY SET FAN	MAIN GARAGE BUS EXHAUST HOSES	NORTH LOWER ROOF	235	2400/2400	2400	4.00	2,325	BELT	15	2.58	3.00	460/3/60	CONSTANT VOLUME WITH SPEED CONTROLLER	(1)

- (1) PROVIDE COMPANION FLANGE, FOR MOUNTING TO FIELD DUCTWORK ON BOTH INLET AND OUTLET CONNECTIONS

REGISTER, GRILLE AND DIFFUSER SCHEDULE

TAG NO.	DESIGN BASIS	MODEL NO.	TYPE	NECK SIZE	MAXIMUM CFM	FACE SIZE	N.C. MAX	MOUNTING TYPE	FINISH	MATERIAL	REMARK
SG-1	KRUEGER	5880	ANODIZED ALUMINUM DOUBLE DEFLECTION SUPPLY GRILLE 3/4" BLADE SPACING	48" x 16"	2500	48" x 16"	20	DUCT	ALUMINIZED	ANODIZED ALUMINUM	(1)
SG-2	KRUEGER	5880	ANODIZED ALUMINUM DOUBLE DEFLECTION SUPPLY GRILLE 3/4" BLADE SPACING	14" x 6"	300	14" x 6"	20	DUCT	ALUMINIZED	ANODIZED ALUMINUM	(1)

- (1) PROVIDE WITH INTEGRAL OPPOSED BLADE DAMPERS

PACKAGED ROOFTOP UNIT SCHEDULE (PART A)

GENERAL DATA						SUPPLY FAN DATA													QUANTITY OF VFD'S	POWER V-Ø-HZ	
TAG NO.	DESIGN BASIS	MODEL NO.	ARRANGEMENT	AREA SERVED	LOCATION	UNIT DIMENSIONS (L x W x H)	UNIT WEIGHT (LBS.)	DESIGN SUPPLY CFM	MIN. O/A CFM	TOTAL SP (IN. WG)	FAN RPM	FAN TYPE	DRIVE TYPE	FAN QTY	MOTOR BHP	MOTOR HP (MINIMUM)	MOTOR TYPE & EFFICIENCY	TYPE OF CONTROL			STARTER TYPE AND RESPONSIBLE CONTRACTOR
ACU-1	TRANE	YHC048F4RHA	VERTICAL DISCHAGE	SHOPS / OFFICES	NORTH LOWER ROOF	88.625 x 53.25 x 32.25	948	1,600	120	1.41	***	FC CENTRIFUGAL	DIRECT	1	0.96	1.00	***	CONSTANT VOLUME	VFD PROVIDED BY UNIT MANUFACTURER	(1) VFD PER MOTOR	480v - 3Ø-60

PACKAGED ROOFTOP UNIT SCHEDULE (PART B)

GENERAL	GAS FIRED HEATING DATA							DX COOLING DATA										FILTER DATA				ELECTRICAL DATA				REMARKS		
	TAG NO.	TOTAL INPUT (MBH)	TOTAL OUTPUT (MBH)	NO. BURNERS	NO. STAGES	GAS INLET PRESS. MIN (IN. WG)	GAS INLET PRESS. MAX (IN. WG)	E.A.T DB °F	L.A.T DB °F	TOTAL MBH	SENSIBLE MBH	SENSIBLE MBH	E.A.T DB °F	E.A.T WB °F	L.A.T DB °F	L.A.T WB °F	COIL FACE AREA (FT²)	COIL FACE VEL (FT/MIN)	# OF COND. FANS	# OF COMP.	REFRIG. CHARGE (LBS)	PRE-FILTER TYPE	PRE-FILTER MERV RATING	MAX. CLEAN APD (IN WG)	MCA (AMPS)		MOCP (AMPS)	ARI MIN. EER
ACU-1	120.0	99.13	3	1	4.5	14	55°	110.7°	49.93	31.94	31.94	80.0°	67.0°	61.78°	57.72°	9.27	173	1	1	5.2	2" THK 65%	8	.40"	11.0	15	***	***	(1) (2) (3) (4) (5) (6) (7)

- (1) UNIT MUST BE PROVIDED WITH A NATURAL GAS EXTERNAL PRESSURE REDUCING VALVE, TO BE INSTALLED BELOW THE ROOFLINE AT THE UNIT.
- (2) DIRECT DRIVE VARIABLE SPEED FAN MOTOR AND FACTORY INSTALLED POTENTIOMETER FOR MANUAL BALANCING OF CONSTANT VOLUME SYSTEM. VFD SHALL HAVE INTERFACE CAPABILITY FOR JCI START/STOP STATUS.
- (3) UNIT TO HAVE FACTORY SUPPORTS AS NEEDED TO REST ON FIELD PROVIDED STEEL DUNNAGE.
- (4) FACTORY WIRED FUSED DISCONNECT FOR SINGLE POINT ELECTRICAL CONNECTION
- (5) 115V 20AMP FACTORY UN-POWERED CONVENIENCE OUTLET. POWER TO BE PROVIDED BY ELECTRICAL CONTRACTOR. SEE ELEC. DWGS.
- (6) (2) SETS OF MERV 13 FILTERS
- (7) HINGED ACCESS DOORS

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL	SEAL
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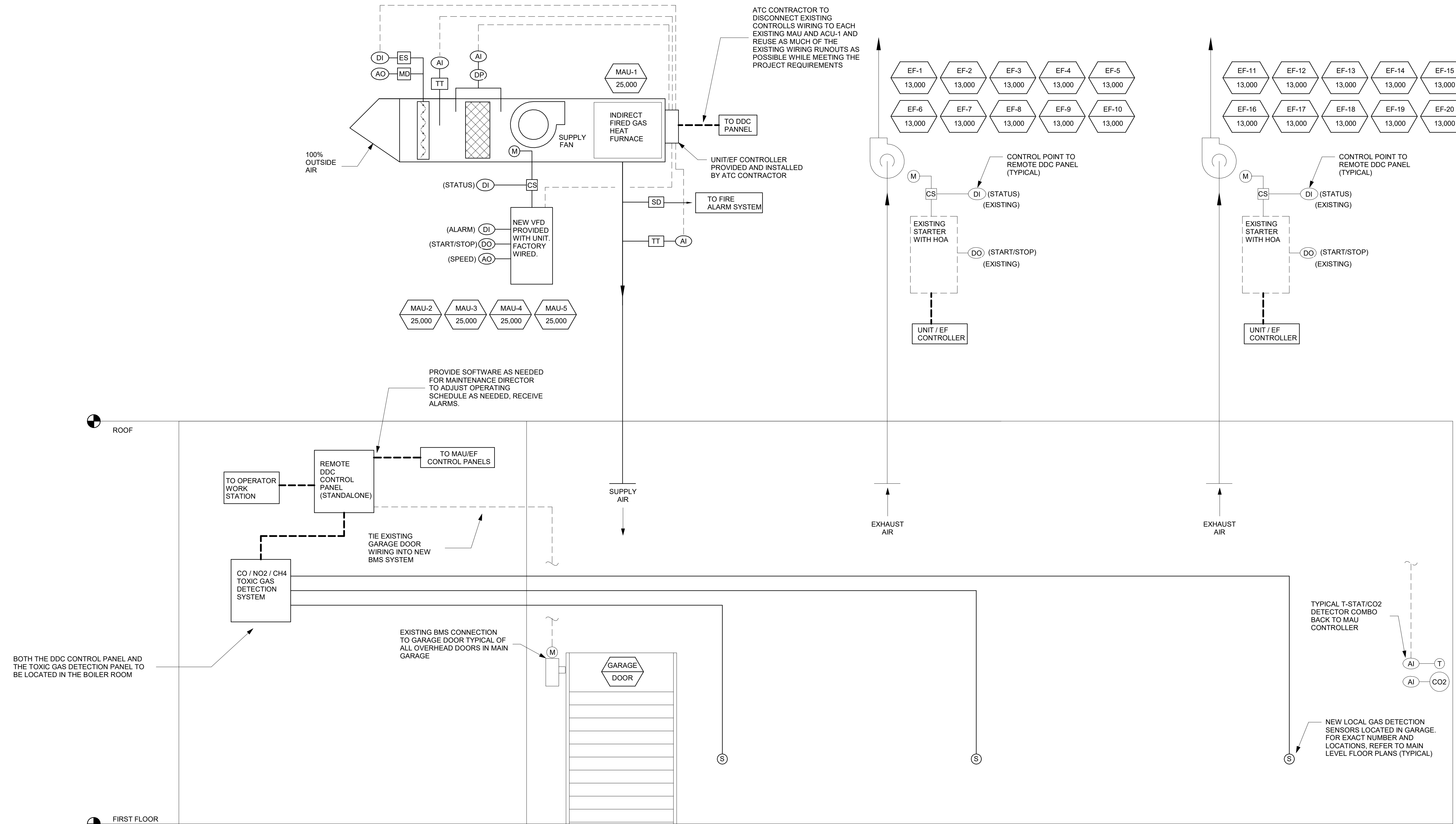
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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
MECHANICAL EQUIPMENT SCHEDULE
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
M-800



MAU & EF SYSTEMS CONTROL DIAGRAM

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
MAU CONTROL DIAGRAM
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
M-900

MAU & EF - CONTROL SEQUENCE

START/STOP CONTROL

- MAU 1, 2, 3, 4, 5, & EF 1 THRU 20 SHALL BE ENABLED/DISABLED BY THE BUILDING BMS BASED ON OCCUPANCY. ALL RTU'S AND EF1 THRU 20 SHALL OPERATE DURING THE OCCUPIED HOURS OF OPERATION BOTH ON WEEKDAYS AND WEEKENDS WHEN REQUIRED. DURING ANY UNOCCUPIED TIME, THE RTU'S AND EF'S ARE TO SHUT DOWN.

MAU & EF CONTROL

- EACH RTU & EF SHALL BE CONTROLLED BY THE BMS.
- ONCE ENABLED BOTH MAU AND EXHAUST FANS SHALL RUN ONCE THE INTAKE DAMPERS ARE PROVEN OPEN.
- ONCE DISABLED BOTH MAU AND EXHAUST FANS SHALL BE DE-ENERGIZED AND INTAKE DAMPERS SHALL BE CLOSED.
- EACH RTU SHALL BE PROVIDED WITH VFD'S AND VFD RATED MOTORS CONTROLLED TO A MINIMUM SETPOINT (8750 CFM). VFD'S TO BE SHIPPED PRE-WIRED TO EACH FAN MOUNTED IN PROPERLY VENTILATED CONTROL ENCLOSURE. THE VFD SHALL BE SET TO SUPPLY A VOLUME OF 25,000 CFM. THE MAX RTU CFM TO BE A HZ SETTING LIMIT THAT IS INPUTTED BY THE EQUIPMENT MANUFACTURER WORKING WITH THE AIR BALANCER.
- THE CFM SETPOINT SHALL BE RESET BASED ON THE CO2 LEVELS IN THE SPACE. IF THERE IS NO VENTILATION REQUIREMENT BASED ON THE TOXIC GAS CONCENTRATION, THE MAU'S ARE TO MODULATE DOWN TO THEIR INDICATED MINIMUM OPERATION.
- THE GAS HEATING SECTION OF THE MAU SHALL BE ACTIVATED BY ANY INSTANCE WHERE THE OUTDOOR AIR TEMPERATURE FALLS BELOW 60° F.
- THE DISCHARGE AIR TEMPERATURE SHALL BE RESET BY THE BMS BASED ON THE ZONE TEMPERATURE AND THE EFFECTIVE HEATING SETPOINT. THE DISCHARGE SETPOINT SHALL RESET BETWEEN 55°-75° WITH ANY OUTDOOR AIR TEMPERATURE BELOW 50° RESULTING IN A 75° DISCHARGE TEMPERATURE
- A HIGH TEMPERATURE SAFETY SHALL BE PROVIDED TO SHUT DOWN EACH ASSOCIATED MAU IF A DISCHARGE OF TEMP. ABOVE 95 DEG. F (ADJUSTABLE) IS DETECTED.
- FACTORY INSTALLED CONTROLS, AIRFLOW SWITCHES, DOOR INTERLOCKS, ETC. SHALL BE PROVIDED TO PROTECT THE COIL FROM OPERATING IN UNSAFE CONDITIONS.
- THE BUILDING EXHAUST FANS EF 1 THRU 20 SHALL BE STAGED TO MATCH THE AMOUNT OF MAKEUP AIR BEING INTRODUCED INTO THE BUILDING BY THE MAU SYSTEM. WHEN THE MAU IS RUNNING BETWEEN THE MINIMUM SETTING AND 50% AIRFLOW, ONE EXHAUST FAN SHALL BE ACTIVE. ONCE THE UNIT RAMP'S ABOVE 50% OF DESIGN AIRFLOW (2) FANS SHALL BE ACTIVE. THE EXHAUST FAN DUTY SHALL ALSO BE CYCLED TO PROVIDE EQUAL RUN TIME.

SMOKE DETECTION

- A SMOKE DETECTOR (SD) SHALL BE INSTALLED IN EACH MAU SUPPLY AIR DUCT MAIN UPSTREAM OF ALL TAKE-OFFS AS SHOWN ON THE DRAWINGS.
- IN THE EVENT ANY SMOKE DETECTOR SENSES PRODUCTS OF COMBUSTION, THE MAU SUPPLY FANS AND BUILDING EXHAUST FANS SHALL BE DE-ENERGIZED, INTAKE DAMPERS SHALL BE SHUT AND AN ALARM SIGNALLED TO THE BUILDING CONTROL SYSTEM AND A GENERAL ALARM TO THE FIRE ALARM PANEL. UNIT RESET SHALL BE AT THE FIRE ALARM CONTROL PANEL.

TOXIC GAS DETECTION

- TOXIC GAS DETECTION SENSORS SHALL BE INSTALLED THROUGHOUT THE MAIN WORK FLOOR AS INDICATED ON THE FLOOR PLANS. GASES TO BE DETECTED: CO, NO2, AND CH4
- THE INDEPENDENT TOXIC GAS DETECTION SYSTEM IS TO INTERFACE WITH THE BMS TO CONTROL THE MAKEUP AIR SYSTEM.
- AS THE LEVELS OF TOXIC GAS (CO / NO2) RISE IN THE SPACE ABOVE UNSAFE LIMITS, BUT ARE STILL BELOW THE ALARMING LIMIT, THE MAU'S WILL MODULATE UP TO SATISFY THE VENTILATION REQUIREMENTS AND REMOVE THE GASSES FROM THE MAIN FLOOR.
- IF THE TOXIC GAS DETECTION SYSTEM HAS DETECTED LEVELS ABOVE THE LIMIT, EACH MAU IS TO MODULATE UP TO 100% CAPACITY, ALL OF THE EXHAUST FANS (EF 1 THRU 20) ARE TO ACTIVATE, AND THE OVERHEAD GARAGE DOORS AT THE MAIN WORK FLOOR ARE ALL TO OPEN. AN ALARM IS TO BE GENERATED AND SENT TO THE BUILDING CONTROL SYSTEM.

ACU-1 CONTROL SEQUENCE

A. START/STOP CONTROL

- ACU-1 SUPPLY FAN SHALL BE STARTED OR STOPPED VIA THE BMS. UPON RECEIVING THE "START" COMMAND, THE OUTDOOR AIR DAMPER SHALL BE DRIVEN OPEN TO ITS MINIMUM POSITION AND THE RETURN AIR DAMPER TO ITS OPEN POSITION. START/STOP MAY OCCUR AS LONG AS ALL SAFETY OR OPERATING CUTOFF SWITCHES ARE CLOSED. SPECIFICALLY THE SMOKE DETECTOR, AND FREEZE/STAT ARE PERMISSIVE FOR OPERATION OF THE SUPPLY AND RETURN FANS.
- UPON RECEIVING A "STOP" COMMAND FROM THE OPERATOR OR UPON SHUTDOWN BY ANY OPERATING CUTOFF SWITCHES, THE DDC CONTROL SYSTEM SHALL DE-ENERGIZE THE SUPPLY AND RETURN FANS AND CLOSE THE OUTDOOR AIR INTAKE DAMPER.
- THE HARDWIRED DUCT-MOUNTED SMOKE DETECTOR SHALL, UPON SENSING PRODUCTS OF COMBUSTION IN THE AIRSTREAM, SHUT DOWN THE ACU-1.
- THE RTU SHALL BE SHUT DOWN FROM A GENERAL ALARM FROM THE FIRE ALARM SYSTEM.
- ACU-1 SHALL BE CONTROLLED BY ITS OWN INTEGRAL CONTROLS PACKAGE. THE BMS SHALL INTERFACE VIA BACNET WITH THE FOLLOWING POINTS INDICATED AT THE FRONT END BMS VIA THE BACNET INTERFACE :
 - START/STOP/STATUS
 - GENERAL ALARM
 - DISCHARGE AIR TEMPERATURE
 - RETURN AIR TEMP. AND HUMIDITY
 - RETURN AIR CO2 LEVELS WITH ALARMING
 - EXHAUST FANS STATUS
 - SUPPLY FROM STATUS AND SPEED
 - FILTER STATUS VIA DP SWITCH
 - ENTERING MIXED AIR TEMP TO DX COIL
 - OPERATING MODE (COOLING, ECONOMIZER, OCCUPIED, UNOCCUPIED, ETC.)
 - INDICATE COOLING STAGE ENABLED.
 - DAMPERS STATUS AND POSITION
 - GAS HEAT STAGING
- THE RETURN FAN SHALL BE CONTROLLED BY THE BMS WITH A HARD WIRE INTERLOCK WITH RTU-1 AND ONLY OPERATE WHEN ACU-1 IS OPERATING.

B. AIRFLOW - OCCUPIED MODE

- ACU-1 SHALL OPERATE CONTINUOUSLY AT A CONSTANT VOLUME WITH THE OUTSIDE AIR DAMPER AT ITS MINIMUM POSITION WHEN THE SPACE IS OCCUPIED

C. AIRFLOW - UNOCCUPIED MODE

- ACU-1 SHALL CYCLE ON AND OFF IN 100% RECIRCULATING MODE WITH THE RETURN AIR DAMPER OPEN AND THE OUTSIDE AIR DAMPER SHUT.

D. TEMPERATURE CONTROL - OCCUPIED HEATING MODE

- GAS FURNACE SHALL BE MODULATED AS REQUIRED TO MAINTAIN A MINIMUM DISCHARGE TEMPERATURE OF 55° F (ADJUSTABLE) AS SENSED BY THE DUCT MOUNTED DISCHARGE AIR TEMPERATURE SENSOR. THE CONTROLS SHALL BE PROVIDED AND INSTALLED BY THE ATC SUBCONTRACTOR.
- GAS STAGING SHALL BE CONTROLLED BY THE GREATEST DEMAND OF ALL THE SPACE THERMOSTATS. SPACE HEATING SETPOINTS SHALL BE 72 DEG. F.
- THE WARM-UP MODE SHALL BE INITIATED VIA OPTIMAL STOP/START AND SHALL BE STARTED A MINIMUM OF (1) HOUR BEFORE THE BLDG. IS OCCUPIED. DURING THIS MODE DISCHARGE AIR SHALL BE CONTROLLED TO 90 DEG. F. (ADJ.) UNTIL ALL OF THE SPACE THERMOSTATS HAVE REACHED THEIR OCCUPIED SETPOINT OF 70 DEG. F. ONCE THE SPACE TEMPERATURE SENSORS ARE ALL SATISFIED THE RTU CONTROL WILL SWITCH TO THE OCCUPIED MODE CONTROL SEQUENCE. DURING THE MORNING WARM-UP MODE ALL DAMPERS SHALL BE WIDE OPEN AND OUTSIDE AIR DAMPER CLOSED WITH RETURN AIR FAN IN OPERATION RETURNING 100% OF THE SUPPLY AIRFLOW.

E. TEMPERATURE CONTROL - UNOCCUPIED HEATING MODE

- ACU-1 SHALL CYCLE ON AND OFF AS REQUIRED TO MAINTAIN A HEATING SPACE SET-BACK TEMPERATURE OF 55° F (ADJUSTABLE) AS SENSED BY THE SPACE TEMPERATURE SENSORS. DURING THE UNOCCUPIED MODE, THE OUTSIDE AIR DAMPER SHALL BE CLOSED AND RETURN DAMPER OPEN. GAS HEAT SHALL BE USED AS THE SECOND STAGE OF HEATING. THE FIRST STAGE OF HEAT SHALL BE FROM THE SPACE BASEBOARD. IF SPACE TEMPS ARE NOT MEETING SETPOINTS OR DRIFT OFF MORE THAN 5 DEGREES, THEN THE FIRST STAGE OF GAS HEAT SHALL BE ENABLED. IF THE SPACE THERMOSTATS SET-BACK TEMPS. ARE STILL NOT REACHED, THEN THE SECOND STAGE OF GAS HEATING WILL BE ENABLED.

ACU-1 CONTROL SEQUENCE CONT.

F. TEMPERATURE CONTROL - OCCUPIED COOLING MODE

- DX COOLING SHALL BE MODULATED AS REQUIRED TO MAINTAIN A HIGH LIMIT OF 60° F. SENSED BY THE DUCT MOUNTED DISCHARGE AIR TEMPERATURE SENSOR, AND REPORTED TO THE BMS. SPACE TEMPERATURE SETPOINT SHALL BE 75 DEG. F. COOLING STAGING SHALL BE CONTROLLED BY THE GREATEST ZONE DEMAND OF ALL THE SPACE THERMOSTATS.
- DURING THE COOLING SEASON THE FIRST MEANS OF COOLING SHALL BE ACTIVATION OF THE ECONOMIZER AS DESCRIBED BELOW. ONCE THE ECONOMIZER CANNOT SATISFY THE COOLING DEMAND OF THE BUILDING, THEN THE OUTSIDE AIR DAMPER SHALL CLOSE ITS MINIMUM POSITION AND THEN THE COOLING CONTROL VALVE SHALL OPEN AND CONTROL AS DESCRIBED ABOVE.
- DISCHARGE AIR TEMPERATURE SHALL BE PROVIDED FOR INDICATION OF LOW DISCHARGE AIR TEMPERATURE.
- RETURN AIR TEMPERATURE AND HUMIDITY SHALL BE MONITORED BY THE BMS SYSTEM.
- SPACE TEMPERATURE SHALL BE MONITORED BY THE BMS SYSTEM.

G. TEMPERATURE CONTROL - UNOCCUPIED COOLING MODE

- DURING THE UNOCCUPIED COOLING MODE THE UNIT SHALL BE OFF.

H. COOL DOWN MODE

- THE COOL DOWN MODE SHALL BE INITIATED VIA OPTIMAL STOP/START AND SHALL BE STARTED A MINIMUM OF (1) HOUR BEFORE THE BLDG. IS OCCUPIED. DURING THIS MODE DISCHARGE AIR SHALL BE CONTROLLED TO 50 DEG. F. (ADJ.) UNTIL ALL OF THE SPACE THERMOSTATS HAVE REACHED THEIR OCCUPIED SETPOINT OF 75 DEG. F. ONCE THE SPACE TEMPERATURE SENSORS ARE ALL SATISFIED THE SYSTEM CONTROL WILL SWITCH TO THE OCCUPIED MODE CONTROL SEQUENCE.
- ALL SPACE PRESSURE AND VFD CONTROL SEQUENCES SHALL REMAIN AS IS IN THE OCCUPIED MODE.
- OUTSIDE AIR DAMPER SHALL BE CLOSED WITH FULL RETURN AIR.

I. FREEZE ALARM

- IF THE DISCHARGE AIR TEMPERATURE SENSOR SENSES A SUPPLY AIR TEMPERATURE OF 35° F (ADJUSTABLE) OR LESS, THE UNIT SHALL SHUT DOWN ON FREEZE AND REQUIRE MANUAL STARTING AT THE UNIT CONTROLLER. AN ALARM SHALL BE SIGNALLED TO THE BMS THAT A LOW DUCT TEMPERATURE HAS OCCURRED.

J. SAFETY PRIORITIES

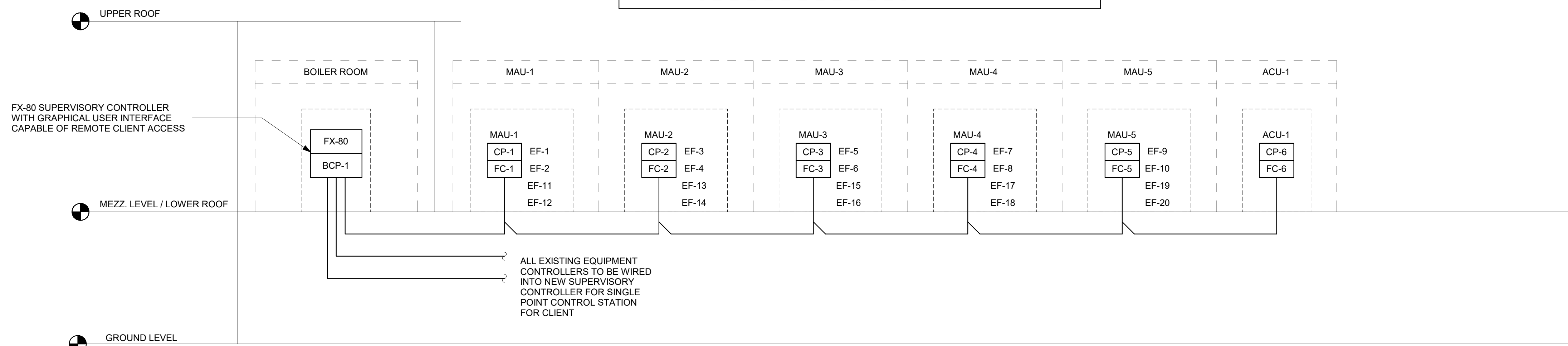
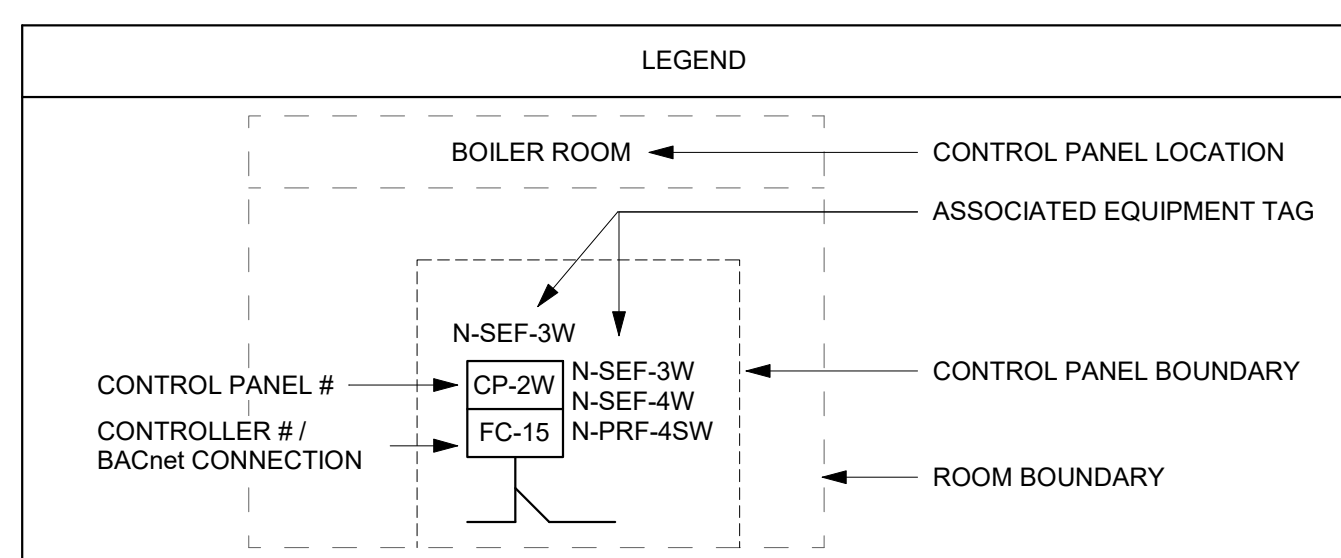
- A PRIORITY STRUCTURE APPLIES TO THE ABOVE CONTROL APPLICATIONS TO ENSURE THAT SAFETY IS MAINTAINED AS THE HIGHEST CONTROL PRIORITY WHEN THE SYSTEM OR INDIVIDUAL COMPONENTS CANNOT MEET ALL DEMANDS PLACED UPON THE SYSTEM:
 - SMOKE DETECTION - (FIRST HIGHEST PRIORITY)
 - ROOM TEMPERATURE CONTROL - (SECOND LEVEL OF PRIORITY)

K. ECONOMIZER CONTROL

- AN OUTDOOR ENTHALPY ECONOMIZER CONTROLLER SHALL BE PROVIDED & CONTROLLED BY THE PACKAGED UNIT CONTROLS. WHEN THE OUTDOOR ENTHALPY CAN SATISFY SPACE COOLING REQUIREMENTS (SPACE TEM80°F ADJUSTABLE) AND THE OUTDOOR AIR TEMPERATURE IS 60° F (ADJUSTABLE) AND BELOW, THE RETURN AND OUTSIDE AIR DAMPERS SHALL MODULATE TO ALLOW FREE COOLING. AS THE MIXED AIR TEMPERATURE DROPS BELOW 50°F (ADJUSTABLE) OR WHEN THE OUTDOOR ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY, THE OUTSIDE AIR DAMPER SHALL MODULATE TO ITS MINIMUM POSITION AND THE RETURN AIR DAMPER SHALL MODULATE TO ITS MAXIMUM POSITION.
- THE UNITS POWER EXHAUST FANS SHALL OPERATE IN THE OCCUPIED MODE DURING FULL ECONOMIZER ONLY.

L. SMOKE DETECTION

- A SMOKE DETECTOR (SD) SHALL BE INSTALLED IN THE MAIN SUPPLY DUCT DOWNSTREAM OF ALL TAKEOFFS AS SHOWN ON THE DRAWINGS AS WELL AS BOTH RETURN MAINS DOWNSTREAM OF ALL TAKEOFFS AS SHOWN ON THE DRAWINGS.
- IN THE EVENT THE DETECTOR SENSES PRODUCTS OF COMBUSTION, THE SUPPLY FAN SHALL BE DE-ENERGIZED AND THE OUTDOOR INTAKE DAMPER SHALL SHUT. AN ALARM SHALL BE SIGNALLED TO THE BUILDING CONTROL SYSTEM AND A GENERAL ALARM TO THE FIRE ALARM PANEL. RESET UNIT AT FIRE ALARM CONTROL PANEL.



ISSUED FOR BID

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Revision Schedule			
No.	DATE	DESCRIPTION	DESIGNER REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB TAE
2	2-06-20	ISSUED FOR BID	MGB TAE

SEAL	SEAL
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SCALE: 12" = 1'-0"

DATUM:

GRAPHIC SCALE

NTS

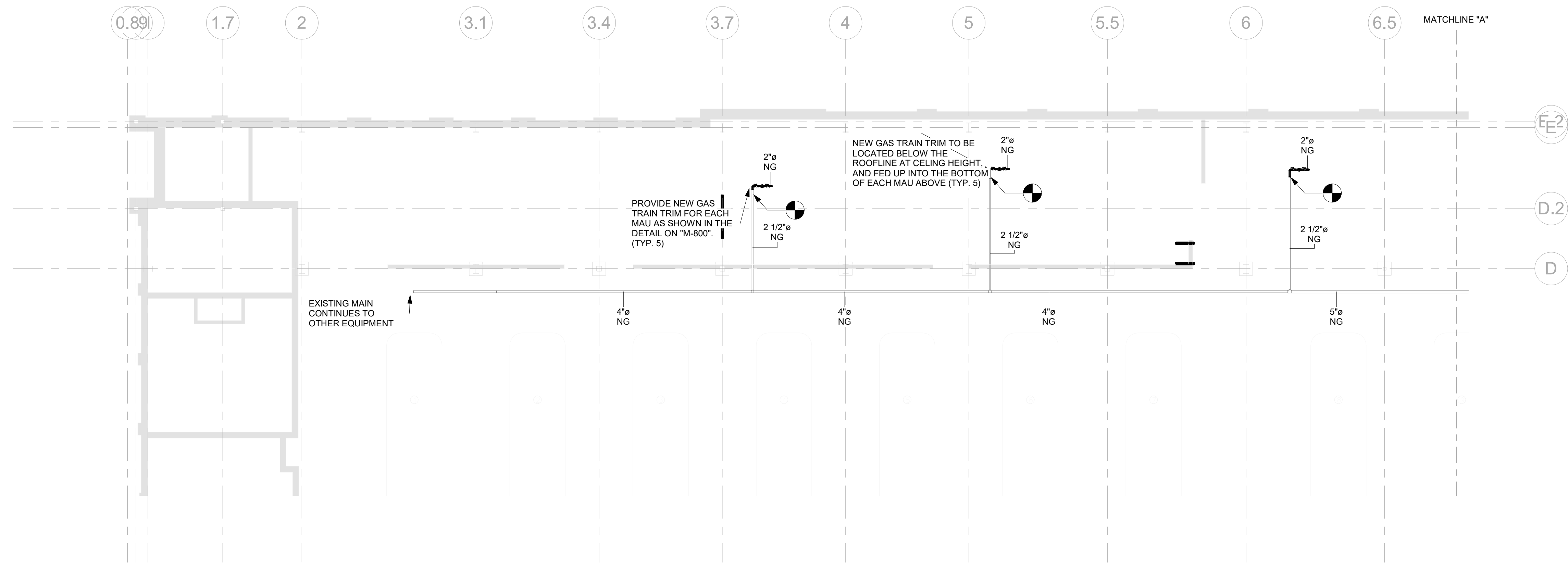
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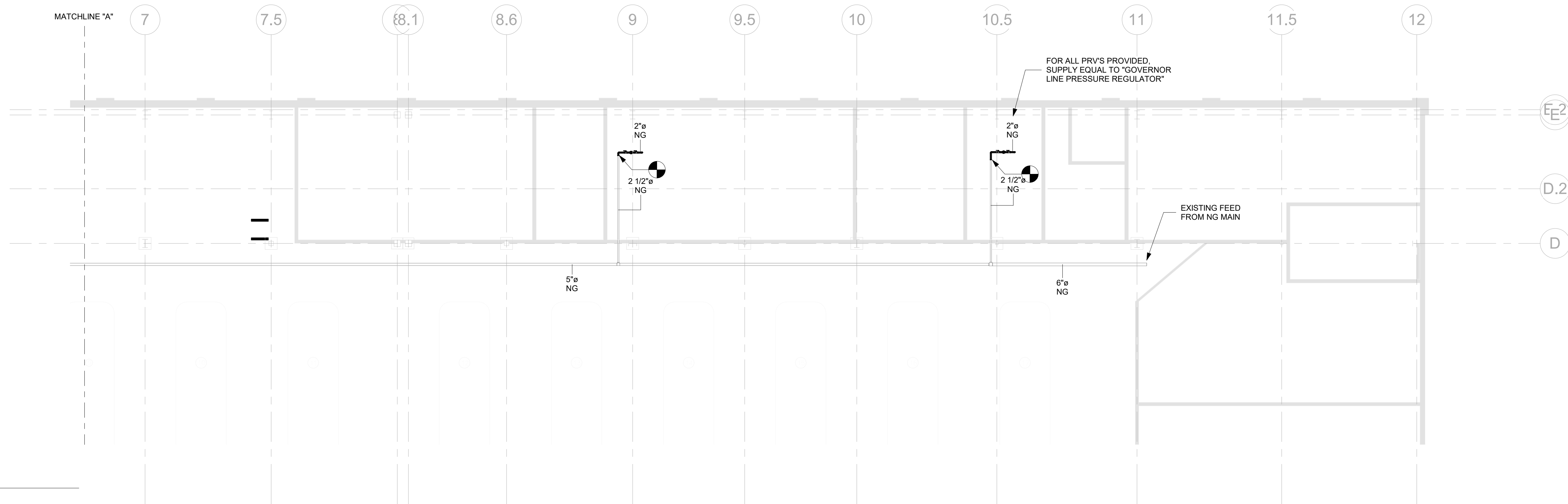
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
BAS NETWORK DIAGRAM & SEQUENCES
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019

M-901



1 - Plmb - East
3/32" = 1'-0"



1 - Plmb - West
3/32" = 1'-0"

ISSUED FOR BID

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL

SEAL



SCALE: 3/32" = 1'-0"

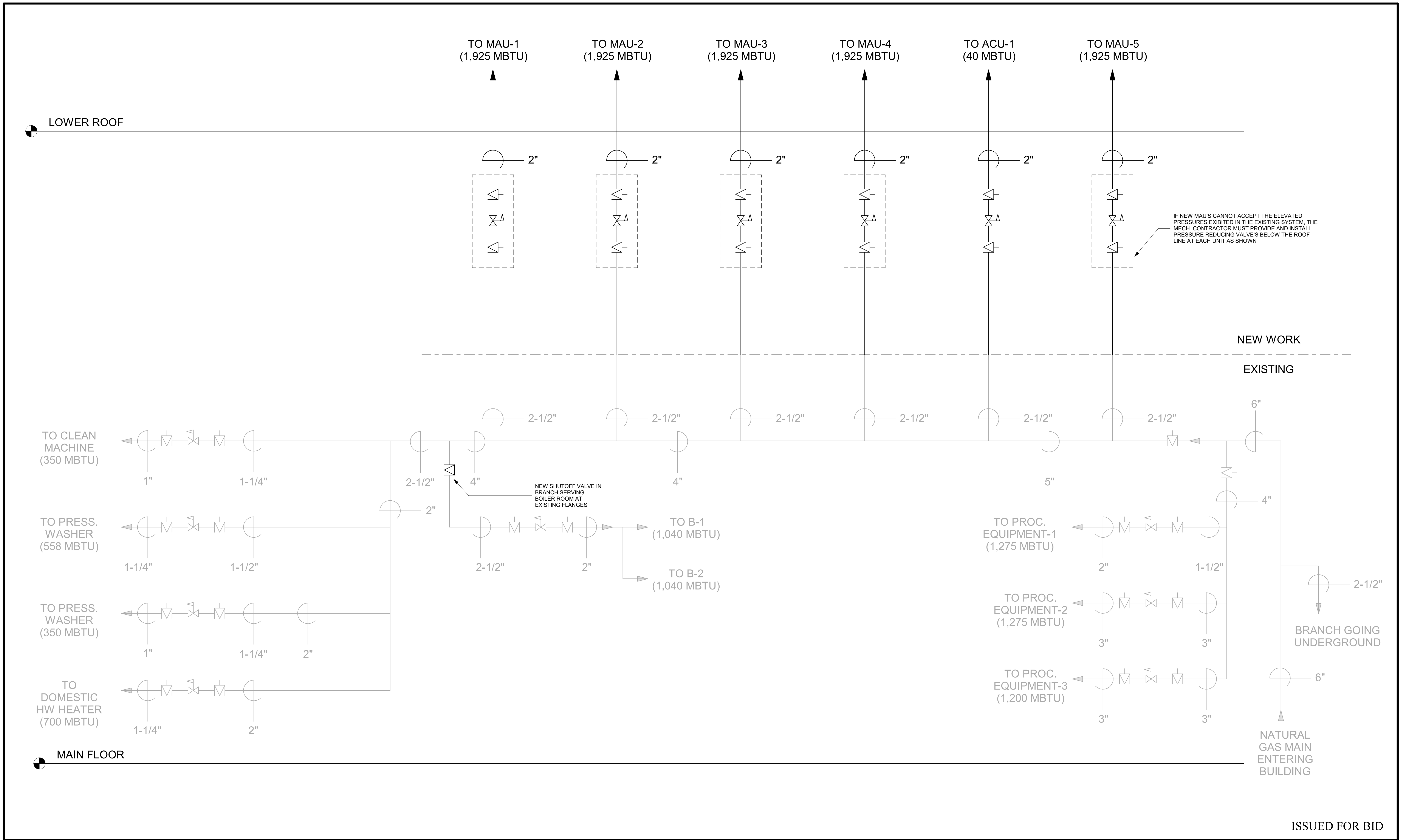
DATUM:

GRAPHIC SCALE



RHODE ISLAND PUBLIC TRANSIT AUTHORITY
NATURAL GAS PIPING LAYOUT
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: AUGUST 30, 2019
P-100



ISSUED FOR BID

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Revision Schedule				
No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1	8-30-19	100% BID DOCUMENTS	MGB	TAE
2	2-06-20	ISSUED FOR BID	MGB	TAE

SEAL

SEAL



SCALE: 12" = 1'-0"

DATUM:

GRAPHIC SCALE

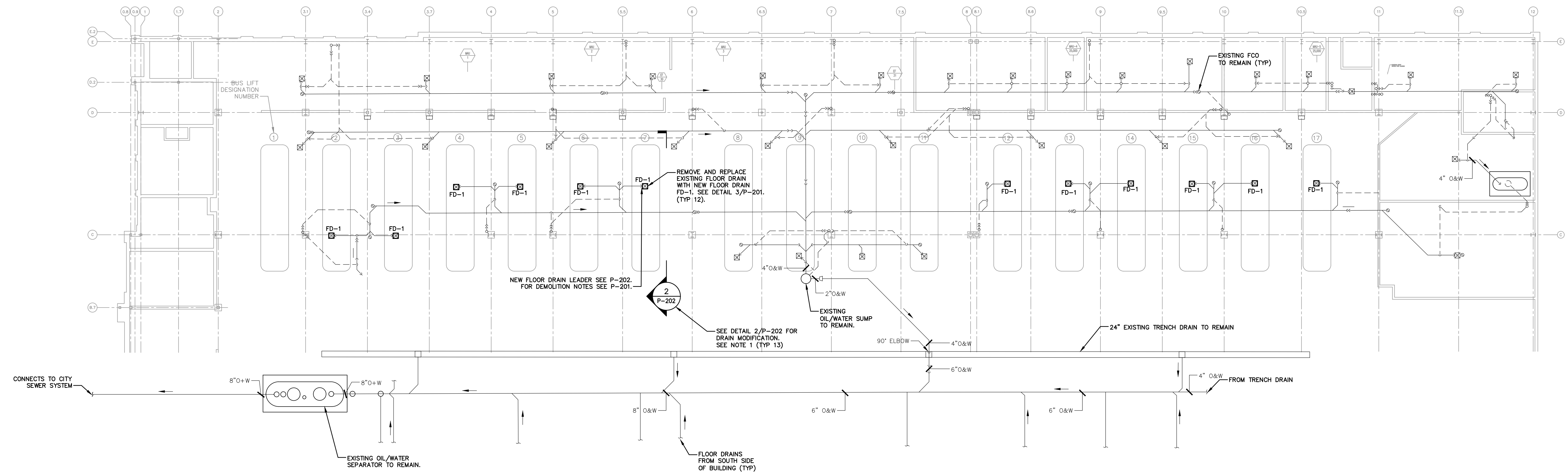
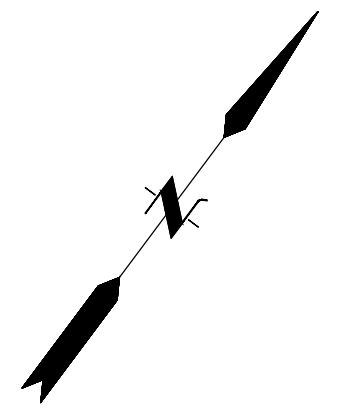
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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 BUILDING NATURAL GAS FLOW DIAGRAM
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: AUGUST 30, 2019
P-101

LINETYPE LEGEND	
	EXISTING TO REMAIN
	NEW WORK



- PLUMBING NOTES:
- BUS LIFTS 2-7, 12-17 TO BE REPLACED. SEE STRUCTURAL DRAWINGS FOR DETAILS.

ISSUED FOR BID 02/10/2020

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 Plotter: AUTOCAD PDF (GENERAL DOCUMENTATION) PC3 CTB File: FO.STB
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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
2.	2/10/2020	ISSUED FOR BID		
1.	8/30/2019	100% BID DOCUMENTS		

SEAL

SEAL

SCALE:

HORIZ.: 1/16" = 1'-0"

VERT.: _____

DATUM:

HORIZ.: _____

VERT.: _____

GRAPHIC SCALE

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RHODE ISLAND PUBLIC TRANSIT AUTHORITY

PLUMBING NEW WORK - SANITARY AND VENT

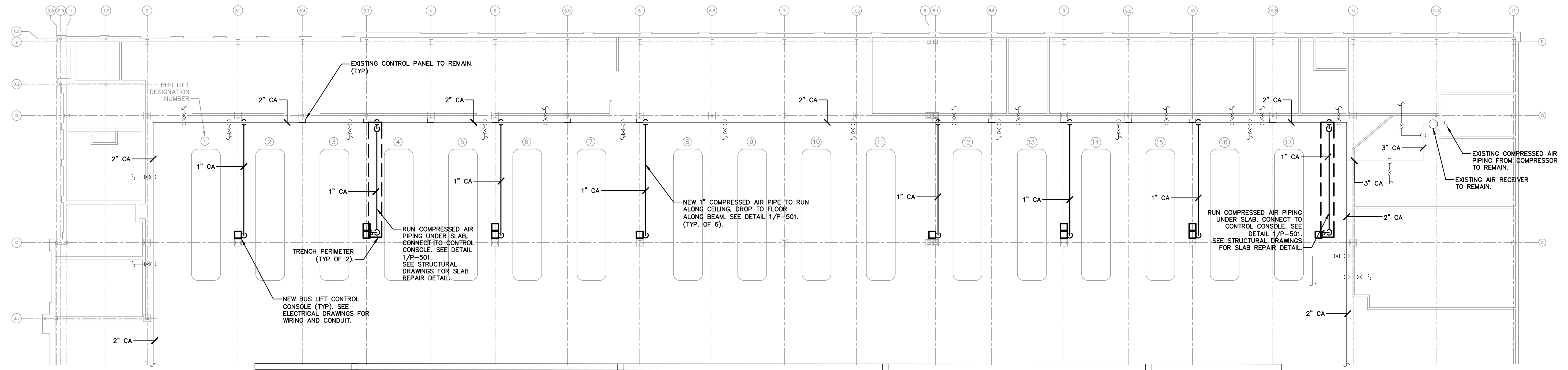
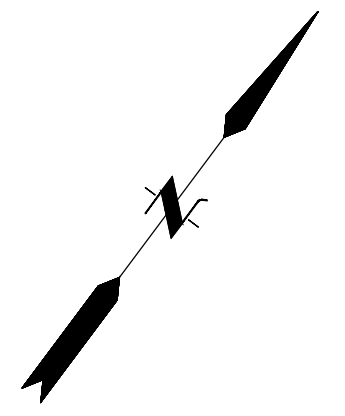
750 ELMWOOD AVE - BUS LIFT REPLACEMENT

PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020

P-101

LINETYPE LEGEND	
	EXISTING TO REMAIN
	NEW WORK



PLUMBING NOTES:
 1. BUS LIFTS 2-7, 12-17 TO BE REPLACED. SEE STRUCTURAL DRAWINGS FOR DETAILS.

ISSUED FOR BID 02/10/2020

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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
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1.	8/30/2019	100% BID DOCUMENTS		

SEAL	SEAL
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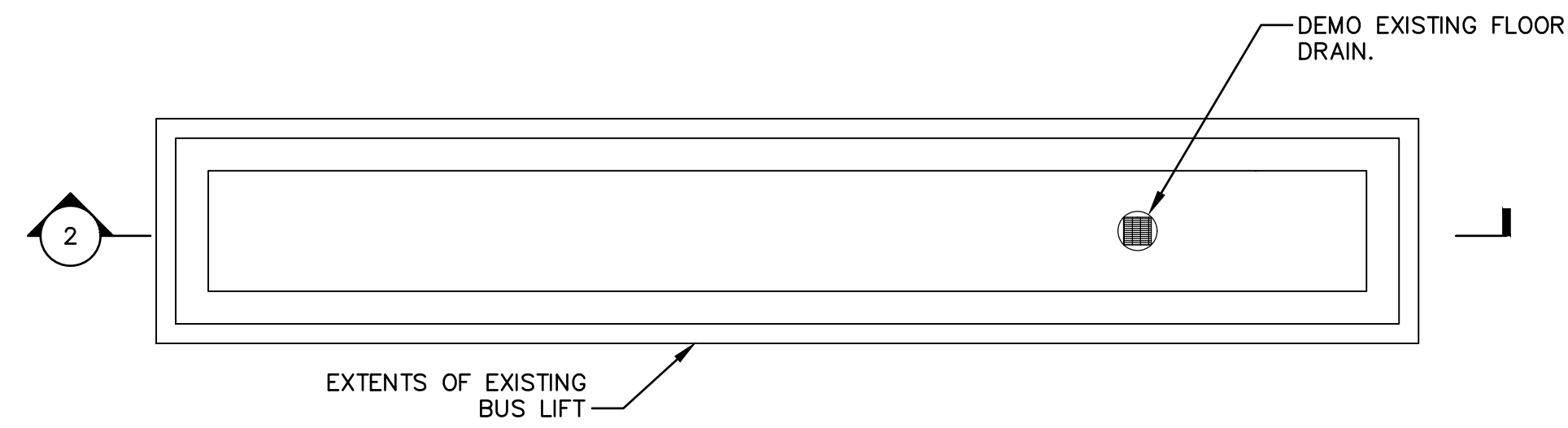
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DATUM:	HORIZ.:
	VERT.:
GRAPHIC SCALE	

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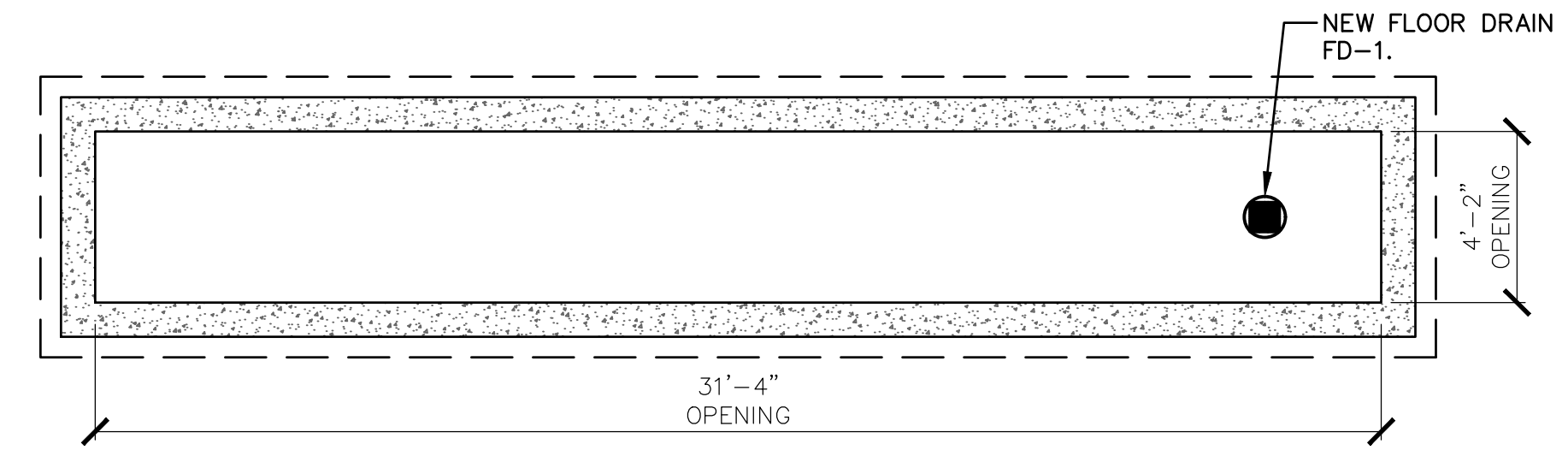
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 PLUMBING - COMPRESSED AIR
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020
P-102

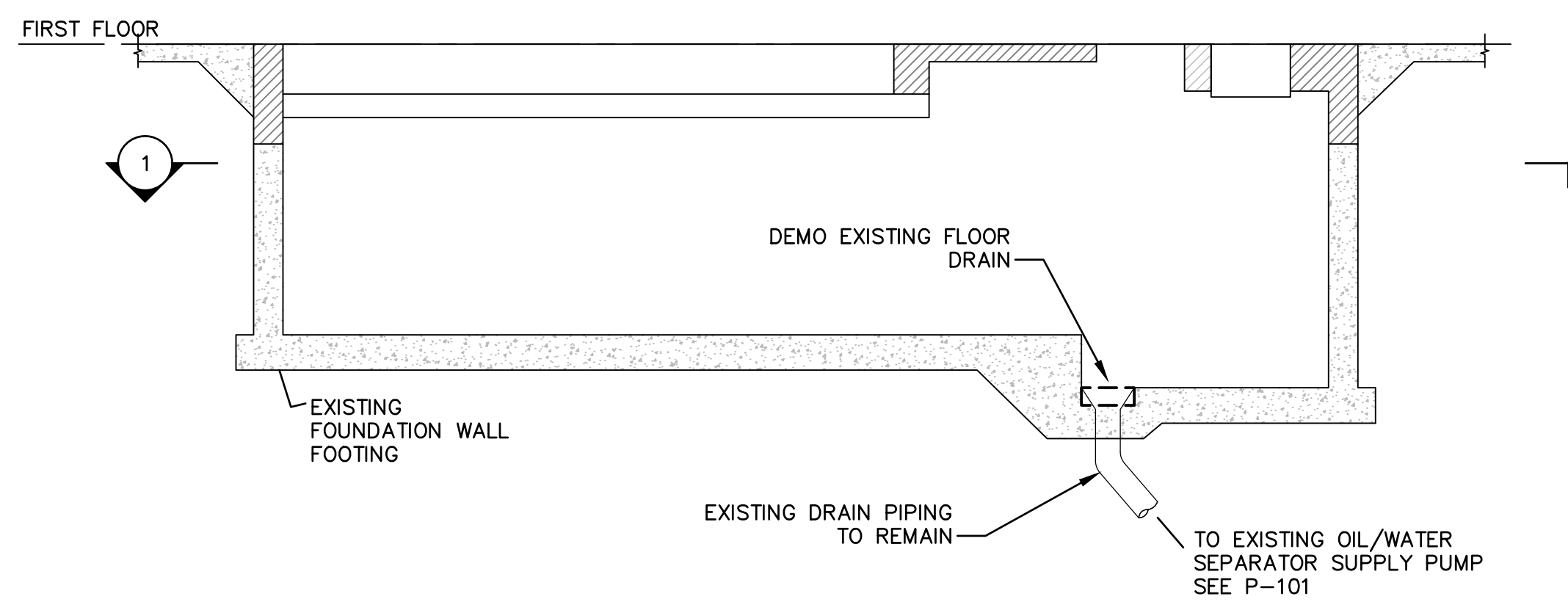
LINETYPE LEGEND	
	EXISTING TO REMAIN
	DEMOLITION
	NEW WORK



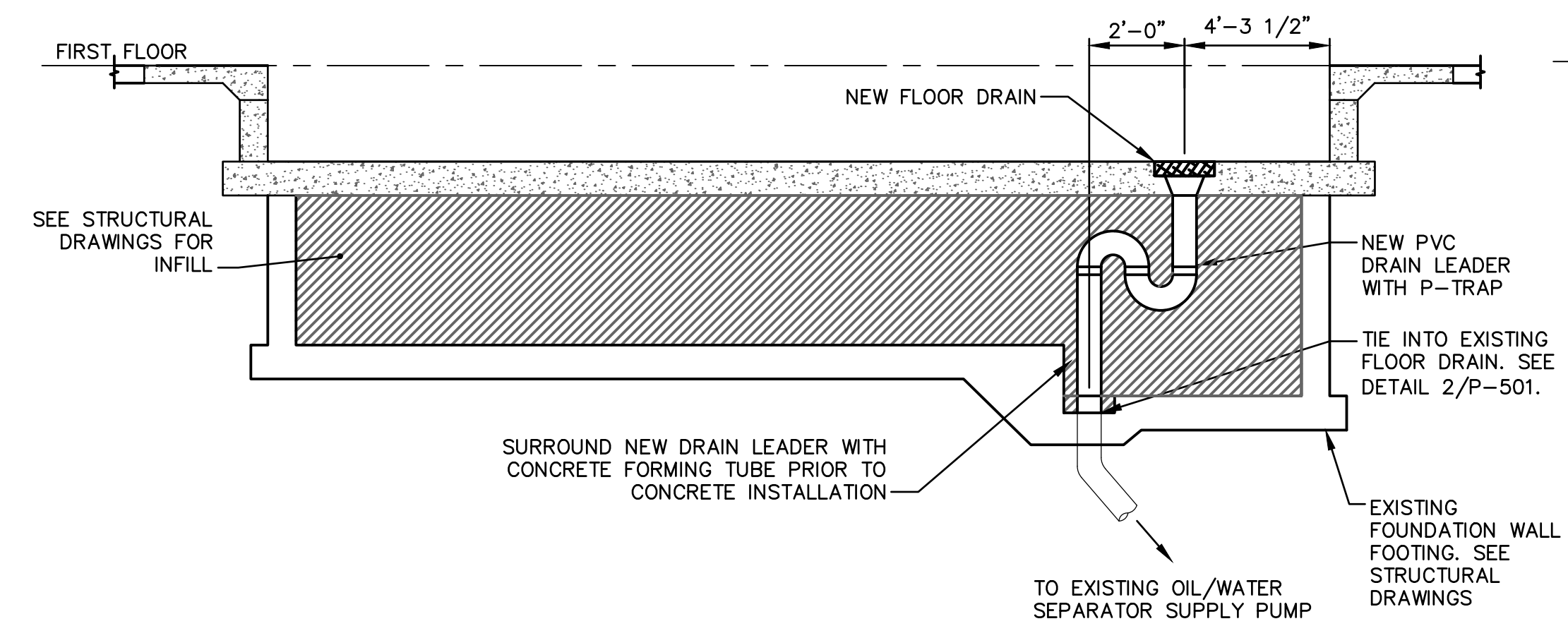
1 PIT PLAN - PLUMBING DEMO
SCALE: 1/4" = 1'-0"



4 PIT PLAN - PLUMBING NEW WORK
SCALE: 1/4" = 1'-0"



2 LONGITUDINAL SECTION - PLUMBING DEMO
SCALE: 1/4" = 1'-0"



3 LONGITUDINAL SECTION - PLUMBING NEW WORK
SCALE: 1/4" = 1'-0"

ISSUED FOR BID 02/10/2020

File Path: J:\DWG\2019\0433A20\MEP\Plumbing\20180433A20_P201.dwg Layout: P-201 User: cwright Date: 2/10/2020 12:13 PM

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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
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1.	8/30/2019	100% BID DOCUMENTS		

SEAL	SEAL
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SCALE:	HORZ.: 1/4" = 1'-0"
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DATUM:	HORZ.:
	VERT.:
GRAPHIC SCALE	

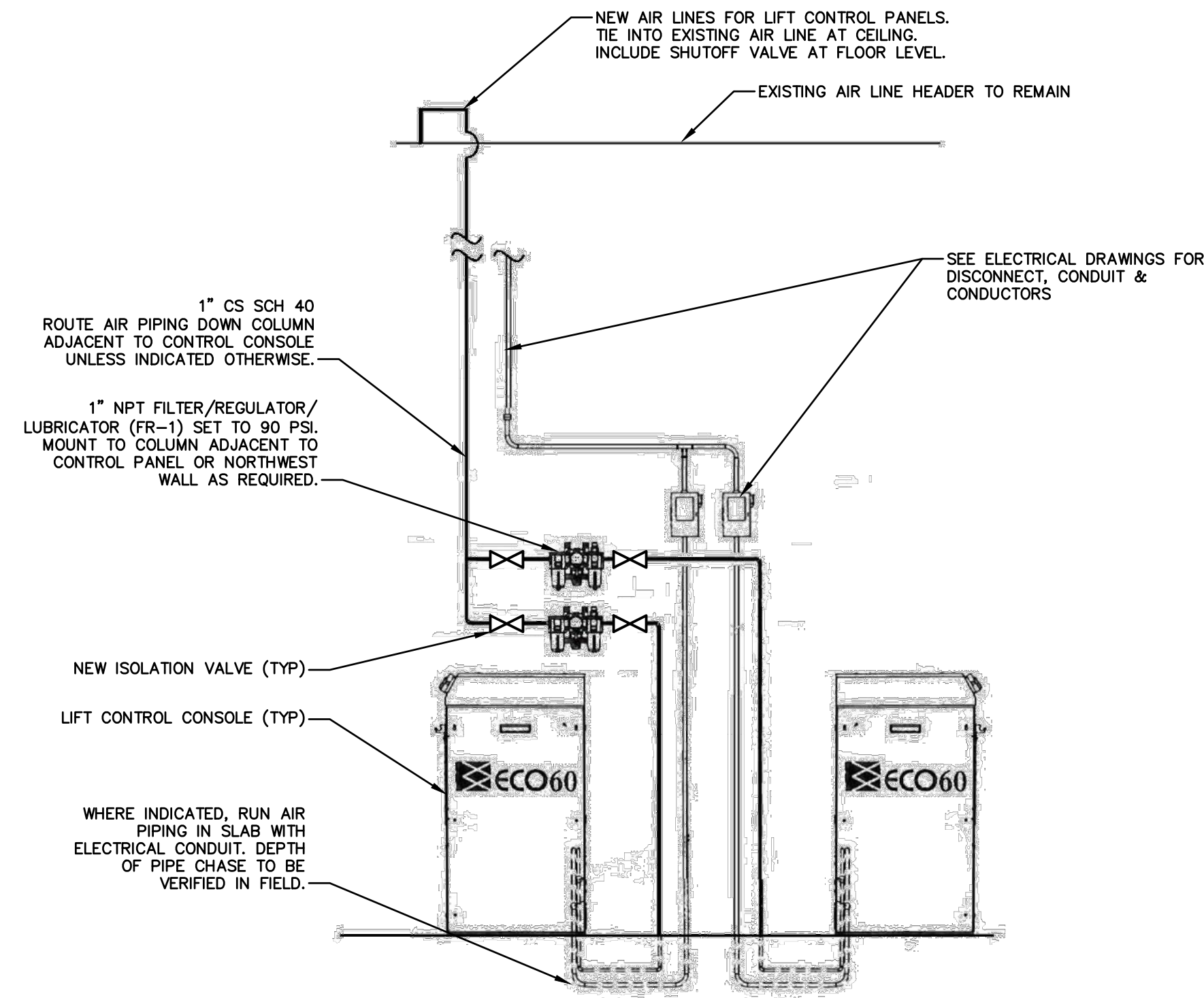
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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
PLUMBING - SECTION VIEWS
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

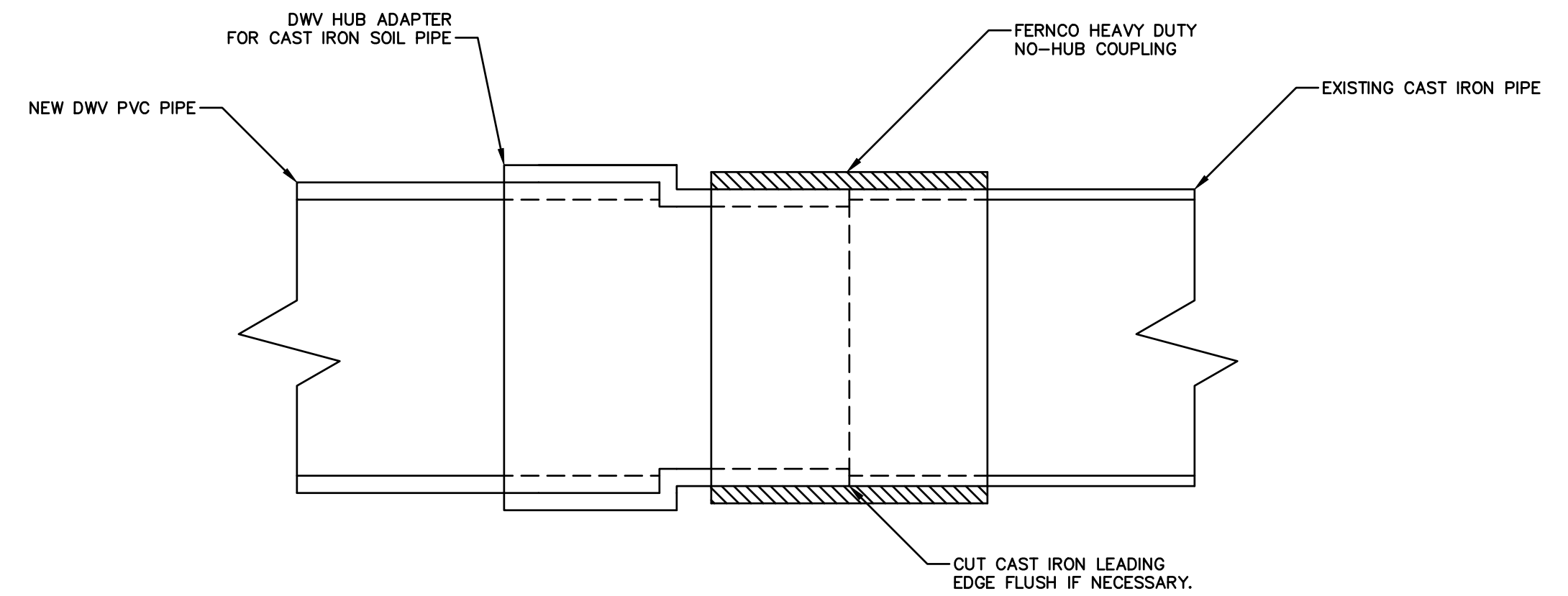
PROJ. No.: 20180433.A20
DATE: FEBRUARY 10, 2020
P-201

PLUMBING FIXTURE SCHEDULE						
SYMBOL	DESCRIPTION	PIPE SIZE	MOUNTING	FIXTURE MANUFACTURER	FIXTURE DESCRIPTION	TRIM DESCRIPTION
FD-1	NO-HUB FLOOR DRAIN	4"	FLOOR	JAY R SMITH	FLOOR DRAIN MODEL 2350Y-SMGB WITH 8 1/2" SQUARE ADJUSTABLE TOP AND "SAFE-SET" SEDIMENT BUCKET.	INCLUDE SQUARE TOP, QUAD CLOSE TRAP SEAL, DUCTILE IRON BUCKET BUCKET AND GRATE.

FILTER REGULATOR SCHEDULE										
SYMBOL	MAKE	MODEL	PIPE SIZE	FILTER RATING	MAX. INCOMING AIR PRESSURE (PSI)	AIR TREATMENT ADJUSTMENT RANGE (PSI)	MAX FLOW (CFM)	LUBRICATOR TYPE	MAX TEMP (F)	DRAIN TYPE
FR-1	SPEEDAIRE	4ZM01	1"	5 MICRON	250	5-150	275	MICRO-MIST	175	MANUAL



1 COMPRESSED AIR DROP TO NEW LIFT CONTROL PANEL
SCALE: N.T.S.



2 PVC PIPE TO EXISTING CAST IRON PIPE CONNECTION DETAIL
SCALE: N.T.S.

ISSUED FOR BID 02/10/2020

File Path: J:\DWG\2019\04\33\A20\MEP\Plumbing\20180433A20_P201.dwg Layout: P-501 Plotter: Mon, February 10, 2020 - 12:13 PM User: owright

LAYER STATE:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
2.	2/10/2020	ISSUED FOR BID		
1.	8/30/2019	100% BID DOCUMENTS		

SEAL	SEAL		
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SCALE:	HORZ.: NTS
	VERT.:
DATUM:	HORZ.:
	VERT.:
GRAPHIC SCALE	

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RHODE ISLAND PUBLIC TRANSIT AUTHORITY
PLUMBING DETAILS & SCHEDULES
750 ELMWOOD AVE - BUS LIFT REPLACEMENT
PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
DATE: FEBRUARY 10, 2020
P-501

LEGEND

S	SINGLE-POLE TOGGLE SWITCH, 20A, 125V. MOUNTED 48" AFF.
S ₃	THREE-WAY TOGGLE SWITCH, 20A, 125V. MOUNTED 48" AFF.
	120/208V, 3Ø, 4W PANELBOARD
	480V, 3Ø, 4W PANELBOARD
T	DRY-TYPE TRANSFORMER SIZE AND TYPE AS INDICATED
J	JUNCTION BOX - SIZE, TYPE AND MOUNTING AS REQUIRED BY NEC
PB	PULLBOX - SIZE, TYPE AND MOUNTING AS REQUIRED BY NEC
-----	ELECTRICAL CONDUIT AND WIRING RUN EXPOSED
-----	ELECTRICAL CONDUIT IN SLAB
----->	ELECTRICAL CONDUIT AND WIRING HOMERUN TO PANELBOARD (3/4"~3/12, 1#12GND) UNLESS OTHERWISE NOTED
	MOTOR; NUMERAL DENOTES HORSEPOWER
	NON-FUSED DISCONNECT SWITCH, 3Ø AMP, 3-POLE, UNLESS OTHERWISE NOTED; "WP" DENOTES WEATHERPROOF, NEMA 3R
ST	MANUAL MOTOR STARTER WITH THERMAL OVERLOAD PROTECTION; "WP" DENOTES WEATHERPROOF, NEMA 3R
MD	MOTOR ACTUATED DAMPER FURNISHED, INSTALLED AND WIRED BY ELECTRICAL CONTRACTOR
VFD	VARIABLE FREQUENCY DRIVE PROVIDED BY MECHANICAL CONTRACTOR INSTALLED AND WIRED BY THE ELECTRICAL CONTRACTOR
GFI WP L1-3	DUPLEX RECEPTACLE, 125V, 20 AMP; "WP" DENOTES WEATHERPROOF; "GFI" DENOTES GROUND-FAULT INTERRUPTING TYPE, MOUNT 48" ABOVE FLOOR; SUBSCRIPT DENOTES PANEL AND CIRCUIT NUMBER
T	THERMOSTAT PROVIDE BY MECHANICAL INSTALLED & WIRED BY ELECTRICAL CONTRACTOR
SD _D	FIRE ALARM DUCT SMOKE DETECTOR
CP	CONTROL PANEL WALL MOUNTED
CC	LIFT CONTROL CONSOLE FLOOR MOUNTED
MAU 1	MECHANICAL EQUIPMENT IDENTIFICATION (UPPER PORTION DENOTES UNIT TYPE; LOWER DENOTES UNIT NO.)

ABBREVIATIONS:

Ø	PHASE
A	AMPERE
ACU	AIR CONDITIONING UNIT
AFF	ABOVE FINISHED FLOOR
ANN	ANNUNCIATOR
ATS	AUTOMATIC TRANSFER SWITCH
C	CONDUIT
CONT	CONTINUED
DISC	DISCONNECT SWITCH
DWG	DRAWING
EF	EXHAUST FAN
EMT	ELECTRICAL METALLIC TUBING
GFI	GROUND-FAULT INTERRUPTING
GND	GROUND
HP	HORSEPOWER
KVA	KILOVOLT AMPERE
KW	KILOWATT
MAU	MAKE UP AIR UNIT
MCB	MAIN CIRCUIT BREAKER
MFOR	MANUFACTURER
PVC	POLY VINYL CHLORIDE
RECEPT.	RECEPTACLE
RSC	RIGID STEEL CONDUIT
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
V	VOLTS
VFD	VARIABLE FREQUENCY DRIVE
WP	WEATHERPROOF (NEMA 3R)
VSD	VARIABLE SPEED DRIVE

GENERAL NOTES:

- ALL ELECTRICAL WORK SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE AND THE STATE OF RHODE ISLAND REQUIREMENTS.
- ADDITIONAL JUNCTION BOXES AND PULLBOXES SHALL BE FURNISHED AND INSTALLED AS REQUIRED.
- ALL CONDUITS SHALL CONTAIN A GREEN SAFETY GROUND WIRE, BOND ALL PANELS, CABINETS, ENCLOSURES, CONDUITS, ETC., AS REQUIRED BY THE NATIONAL ELECTRICAL CODE.
- PROVIDE CONDUIT SLEEVES FILLED WITH AN APPROVED FIRE-RESISTANT MATERIAL WHERE FIRE-RATED WALLS ARE PENETRATED. APPROVED WATERTIGHT CONDUIT SLEEVES SHALL BE INSTALLED WHERE WALLS ARE PENETRATED EITHER ENTERING OR LEAVING A BUILDING.
- POWER BRANCH CIRCUIT WIRING MAY NOT BE SHOWN BUT SHALL BE PROVIDED AS REQUIRED. MINIMUM WIRING SHALL BE 1/2"~2#12, 1#12 GROUND. NO MORE THAN THREE PHASES MAY BE COMBINED IN A SINGLE HOMERUN AND EACH PHASE SHALL BE PROVIDED WITH AN INDIVIDUAL NEUTRAL.
- FOR EXACT LOCATIONS OF MECHANICAL EQUIPMENT, REFER TO MECHANICAL DRAWINGS.
- ALL CUTTING, PATCHING AND FIRESTOPPING RELATED TO ELECTRICAL WORK SHALL BE THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR.
- PROVIDE NEW TYPEWRITTEN PANEL DIRECTORIES FOR ALL PANELS AND PANELS THAT HAVE BEEN MODIFIED.

DEMOLITION NOTES:

- EXISTING ELECTRICAL EQUIPMENT INDICATED ON PLANS HAS BEEN DERIVED FROM THE BEST AVAILABLE EXISTING DRAWINGS AND FIELD VISIT BUT SHALL BE FIELD VERIFIED PRIOR TO CONSTRUCTION AS REQUIRED. ANY EQUIPMENT THAT IS NOT IDENTIFIED AND CONFLICTS WITH CONSTRUCTION SHALL NOT BE DISCONNECTED AND SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER / ENGINEER FOR DISPOSITION.
- WHERE WIRING IS TO BE REMOVED, RELOCATED OR RECONNECTED, THE CONTRACTOR SHALL TAKE PRECAUTIONS AND ASSUME THAT THE CIRCUIT MAY BE ACTIVE. CONTRACTOR SHALL TEST, VERIFY AND SECURE ALL CIRCUITS BEFORE REMOVAL. UNKNOWN WIRING SHALL BE IDENTIFIED. ANY WIRING TO REMAIN SHALL BE VERIFIED BY THE CONTRACTOR, TAGGED AND IDENTIFIED.
- EXISTING ELECTRICAL EQUIPMENT AND DEVICES INDICATED TO BE REMOVED SHALL BE REMOVED COMPLETELY INCLUDING ALL CONDUIT, WIRING AND ASSOCIATED APPURTENANCES BACK TO EXISTING SOURCE AND THE EXISTING SOURCE SHALL BE LABELED AS SPARE. EXISTING CONDUITS TO BE REMOVED WHICH ARE EMBEDDED IN A CONCRETE SLAB SHALL HAVE THE WIRING REMOVED AND THE CONDUIT CUT FLUSH WITH CONCRETE AND SEALED IN AN APPROVED MANNER.
- EXISTING ELECTRICAL EQUIPMENT AND WIRING TO REMAIN SHALL BE PROTECTED FROM DAMAGE AS REQUIRED DURING THE CONSTRUCTION PERIOD AND LEFT IN GOOD WORKING ORDER AT COMPLETION. ANY EQUIPMENT DAMAGED SHALL BE REPLACED BY THE CONTRACTOR AT NO EXPENSE TO THE OWNER.
- OWNER AND CODE REQUIRED SYSTEMS THAT ARE REQUIRED TO REMAIN ACTIVE DURING CONSTRUCTION SHALL BE TEMPORARILY WIRED AS REQUIRED TO REMAIN ACTIVE THROUGHOUT THE CONSTRUCTION PERIOD UNTIL NEW SYSTEMS ARE INSTALLED, TESTED AND ACCEPTED.
- IN CONDITIONS WHERE IN THE OPINION OF THE CONTRACTOR IT IS NOT CLEAR WHETHER EXISTING ELECTRICAL EQUIPMENT IS TO BE REMOVED OR REMAIN, IT SHOULD BE BROUGHT TO THE ATTENTION OF THE ENGINEER FOR REVIEW AND FINAL DECISION.
- ANY DISRUPTION OF ANY ELECTRICAL SERVICE NECESSITATED BY THE ELECTRICAL RENOVATION SHALL BE COORDINATED WITH THE OWNER IN ORDER FOR PROPER NOTICE TO BE GIVEN PRIOR TO THE DISCONNECTION OF ANY SERVICE. PROCESS EQUIPMENT SHALL BE KEPT OPERATIONAL.
- EXISTING ELECTRICAL EQUIPMENT REMOVED SHALL BE BROKEN DOWN INTO MANAGEABLE LENGTHS FOR STORAGE, HANDLING AND PROPER DISPOSAL.
- ELECTRICAL RENOVATION WORK SHALL BE ACCOMPLISHED IN CONFORMANCE WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE.

PANELBOARD SCHEDULE										
PANEL:	PNH11	M.L.O.: 600		NEW REPLACEMENT PANEL						
LOCATION:	EXISTING	MAIN BREAKER		MAIN BREAKER						
VOLTS:	480	A.I.C.: 65,000		A.I.C.: 65,000						
PHASE:	3	MOUNTING: SURFACE		MOUNTING: SURFACE						
WIRE:	3	ENCLOSURE: NEMA 1		ENCLOSURE: NEMA 1						
SOLID NEUTRAL:	30									
POLE PANEL:	30									
CIRCUIT DESCRIPTION		CIRCUIT BREAKER		CIRCUIT BREAKER						
No.	TRIP	POLE	AMPS	Ø	TRIP					
MUA-1 (2@20HP)	1	70	3	53.4	A 53.4					
	3			53.4	B 53.4					
	5			53.4	C 53.4					
MUA-3 (2@20HP)	7	70	3	53.4	A 53.4					
	9			53.4	B 53.4					
	11			53.4	C 53.4					
MUA-5 (2@20HP)	13	70	3	53.4	A 11.0					
	15			53.4	B 11.0					
	17			7.6	C 11.0					
EF-30 (3HP)	19	20	3	1.6	A 0.0					
	21			1.6	B 0.0					
	23			1.6	C 0.0					
SPARE	25	30	3	0.0	A 0.0					
	27			0.0	B 0.0					
	29			0.0	C 0.0					
TOTAL AMPS	A	#####	B	#####	C	#####				

NEW PANEL IN NEW LOCATION TO REPLACE EXISTING PANEL PNH-11.

PANELBOARD SCHEDULE										
PANEL:	PNP12A	M.L.O.: 400		NEW REPLACEMENT PANEL						
LOCATION:	EXISTING	MAIN BREAKER		MAIN BREAKER						
VOLTS:	480	A.I.C.: 65,000		A.I.C.: 65,000						
PHASE:	3	MOUNTING: SURFACE		MOUNTING: SURFACE						
WIRE:	3	ENCLOSURE: NEMA 1		ENCLOSURE: NEMA 1						
SOLID NEUTRAL:	42									
POLE PANEL:	42									
CIRCUIT DESCRIPTION		CIRCUIT BREAKER		CIRCUIT BREAKER						
No.	TRIP	POLE	AMPS	Ø	TRIP					
POST LIFT CONSOLE	1	25	3	15.2	A 15.2					
BAY 17 - 2@5HP	3			15.2	B 15.2					
	5			15.2	C 15.2					
GRINDER RM 132	7	20	3	2.0	A 4.1					
1HP	9			2.0	B 4.1					
	11			2.0	C 4.1					
BEAD BLASTER	13	20	3	2.0	A 21.0					
1HP	15			2.0	B 21.0					
	17			2.0	C 21.0					
JB CRANE RM 132	19	20	3	3.2	A 3.0					
1HP + 1/2HP	21			3.2	B 3.0					
	23			3.2	C 3.0					
RADIAL PRESS RM 136	25	60	3	7.6	A 3.0					
5HP	27			7.6	B 3.0					
	29			7.6	C 3.0					
SPARE	31	35	3	0.0	A 3.0					
	33			0.0	B 3.0					
	35			0.0	C 3.0					
DRILL PRESS RM 128	37	30	3	3.0	A 4.8					
	39			3.0	B 4.8					
	41			3.0	C 4.8					
TOTAL AMPS	A	76.30	B	76.30	C	70.50				

PANELBOARD SCHEDULE										
PANEL:	EXISTING	M.L.O.: 400		FEED THRU						
LOCATION:	EXISTING	MAIN BREAKER		MAIN BREAKER						
VOLTS:	480	A.I.C.: 65,000		A.I.C.: 65,000						
PHASE:	3	MOUNTING: SURFACE		MOUNTING: SURFACE						
WIRE:	3	ENCLOSURE: NEMA 1		ENCLOSURE: NEMA 1						
SOLID NEUTRAL:	42									
POLE PANEL:	42									
CIRCUIT DESCRIPTION		CIRCUIT BREAKER		CIRCUIT BREAKER						
No.	TRIP	POLE	AMPS	Ø	TRIP					
OH DOOR OPERATORS (3)	1	15	3	8.0	A 12.0					
RMS 124-126	3			8.0	B 12.0					
	5			8.0	C 12.0					
POST LIFT CONSOLE	7	25	3	15.2	A 15.2					
BAY 5 - 2@5HP	9			15.2	B 15.2					
	11			15.2	C 15.2					
POST LIFT CONSOLE	13	25	3	15.2	A 21.0					
BAY 7 - 2@5HP	15			15.2	B 21.0					
	17			15.2	C 21.0					
PLAT. LIFT CONSOLE	19	60	3	21.0	A 21.0					
BAY 9 15HP	21			21.0	B 21.0					
	23			21.0	C 21.0					
PLAT. LIFT CONSOLE	25	60	3	21.0	A 15.2					
BAY 11 15HP	27			21.0	B 15.2					
	29			21.0	C 15.2					
POST LIFT CONSOLE	31	25	3	15.2	A 15.2					
BAY 13 - 2@5HP	33			15.2	B 15.2					
	35			15.2	C 15.2					
POST LIFT CONSOLE	37	25	3	15.2	A 54.0					
BAY 15 - 2@5HP	39			15.2	B 54.0					
	41			15.2	C 54.0					
TOTAL AMPS	A	164.80	B	164.80	C	176.80				

PANELBOARD SCHEDULE										
PANEL:	PNP11	M.L.O.: 225		FEED THRU						
LOCATION:	EXISTING	MAIN BREAKER		MAIN BREAKER						
VOLTS:	480	A.I.C.: 225		A.I.C.: 225						
PHASE:	3	MOUNTING: SURFACE		MOUNTING: SURFACE						
WIRE:	3	ENCLOSURE: NEMA 1		ENCLOSURE: NEMA 1						
SOLID NEUTRAL:	42									
POLE PANEL:	42									
CIRCUIT DESCRIPTION		CIRCUIT BREAKER		CIRCUIT BREAKER						
No.	TRIP	POLE	AMPS	Ø	TRIP					
OH DOOR OPERATORS	1	15	3	10.5	A 0.0					
(5) @ 1HP	3			10.5	B 0.0					
	5			10.5	C 0.0					
PLATFORM LIFT CONSOLE	7	60	3	21.0	A 0.0					
RM 146 15HP BAY 24 (RR-2)	9			21.0	B 0.0					
	11			21.0	C 0.0					
PLATFORM LIFT CONSOLE	13	60	3	21.0	A 15.2					
RM 145 15HP BAY 26	15			21.0	B 15.2					
(CB-2)	17			21.0	C 15.2					
COOLING COLUMN PUMP	19	15	3	1.6	A 14.0					
3HP RM 136 (OV-25)	21			1.6	B 14.0					
	23			1.6	C 14.0					
POST LIFT CONSOLE	25	25	3	15.2	A 2.1					
BAY 4 - 2@5HP	27			15.2	B 2.1					
	29			15.2	C 2.1					
BUFFER GRINDER RM 136	31	15	3	3.0	A 8.0					
1 1/2HP (ER-8)	33			3.0	B 8.0					
	35			3.0	C 8.0					
POST LIFT CONSOLE	37	25	3	15.2	A 54.0					
BAY 2 - 2@5HP	39			15.2	B 54.0					
	41			15.2	C 54.0					
TOTAL AMPS	A	100.60	B	100.60	C	150.90				

NOTES:

- BOLD LETTERS INDICATE NEW EQUIPMENT BEING WIRE TO NEW BREAKER DISCONNECT REMOVE EXISTING.
- EXISTING LOADS DERIVED FROM EXISTING DRAWINGS.
- NEW CIRCUIT BREAKERS FOR LIFTS.

ISSUED FOR BID 02/10/2020

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
2.	2/10/2020	ISSUED FOR BID		
1.	8/30/2019	100% BID DOCUMENTS		

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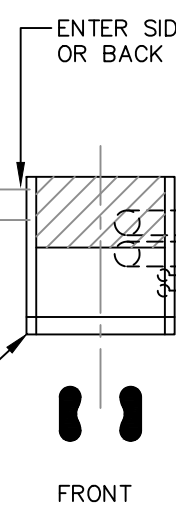
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 ELECTRICAL GENERAL NOTES & LEGEND
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020
E-001

PNEUMATIC LINE-SIDE SUPPLY 90 PSI, 5 CFM, TO INCLUDE REGULATOR, FILTER, LUBRICATOR, DRIER (BY MECHANICAL)

3/4"C-3#12, 1#12 GND. TO LIFT DISCONNECT SWITCH (LIFT POWER SUPPLY)

CONTROL CONSOLE ON HOUSE KEEPING PAD (SEE STRUCTURAL DRAWINGS)



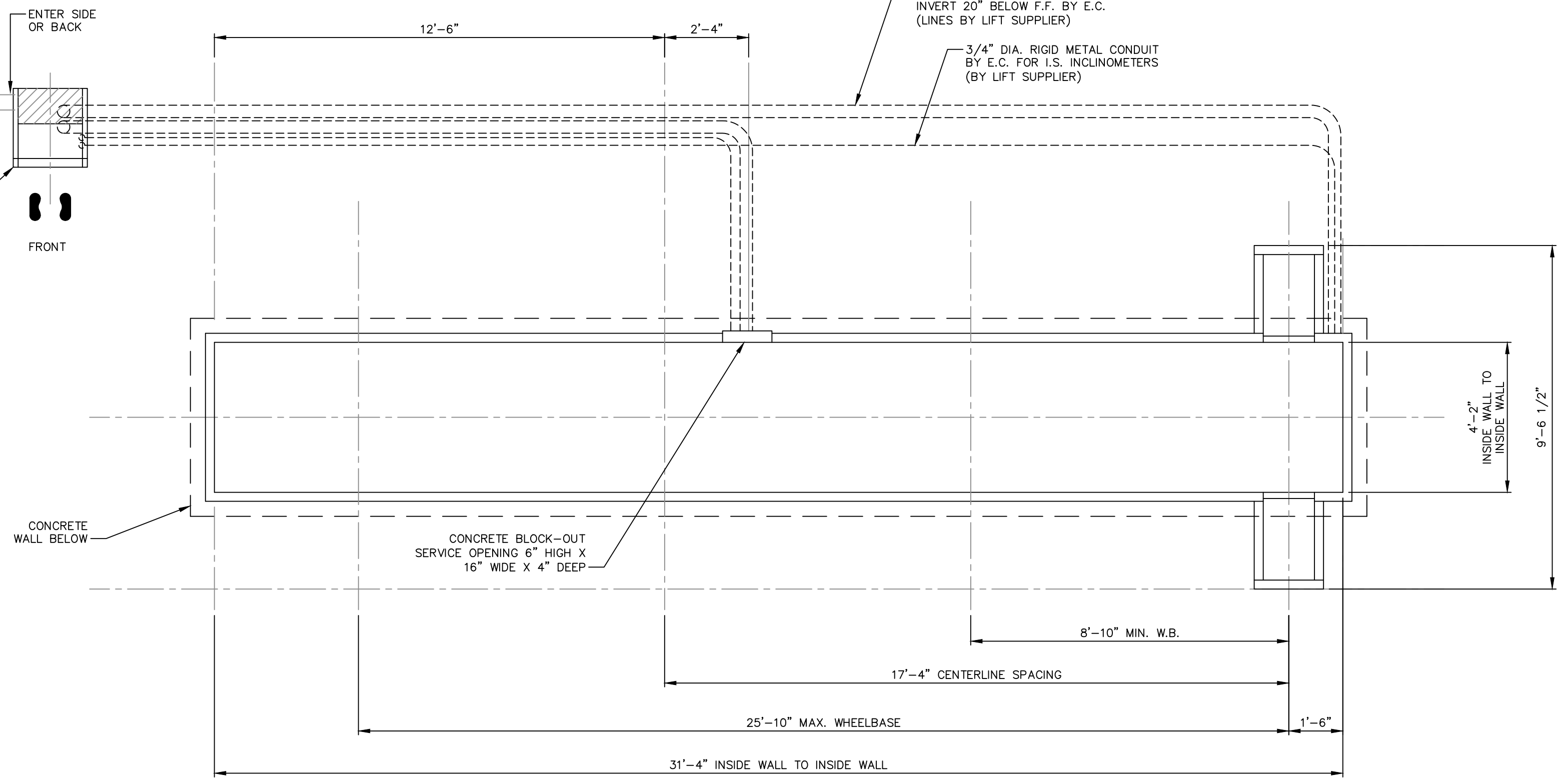
FRONT

CONCRETE WALL BELOW

CONCRETE BLOCK-OUT SERVICE OPENING 6" HIGH X 16" WIDE X 4" DEEP

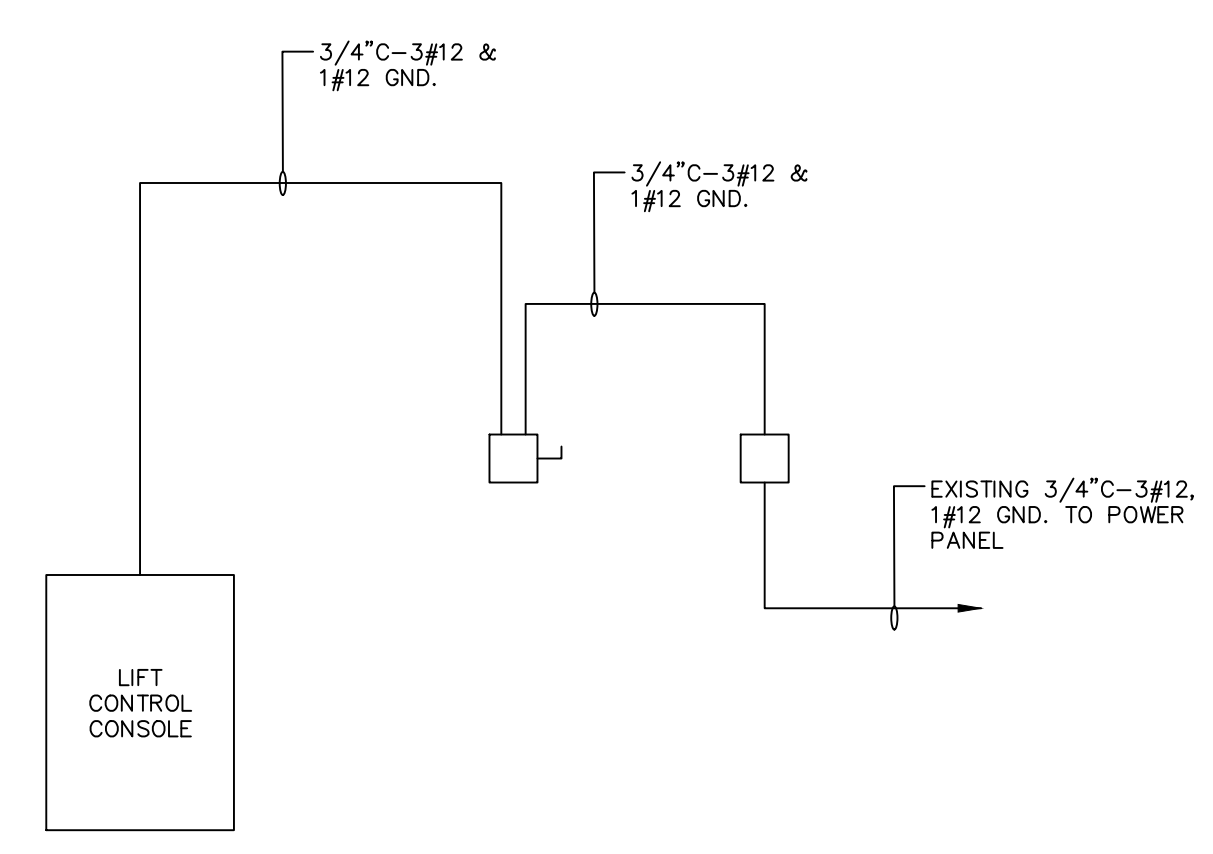
4" DIA. PVC CONDUIT CHASE FOR HYDRAULIC LINES PIPE INVERT 20" BELOW F.F. BY E.C. (LINES BY LIFT SUPPLIER)

3/4" DIA. RIGID METAL CONDUIT BY E.C. FOR I.S. INCLINOMETERS (BY LIFT SUPPLIER)

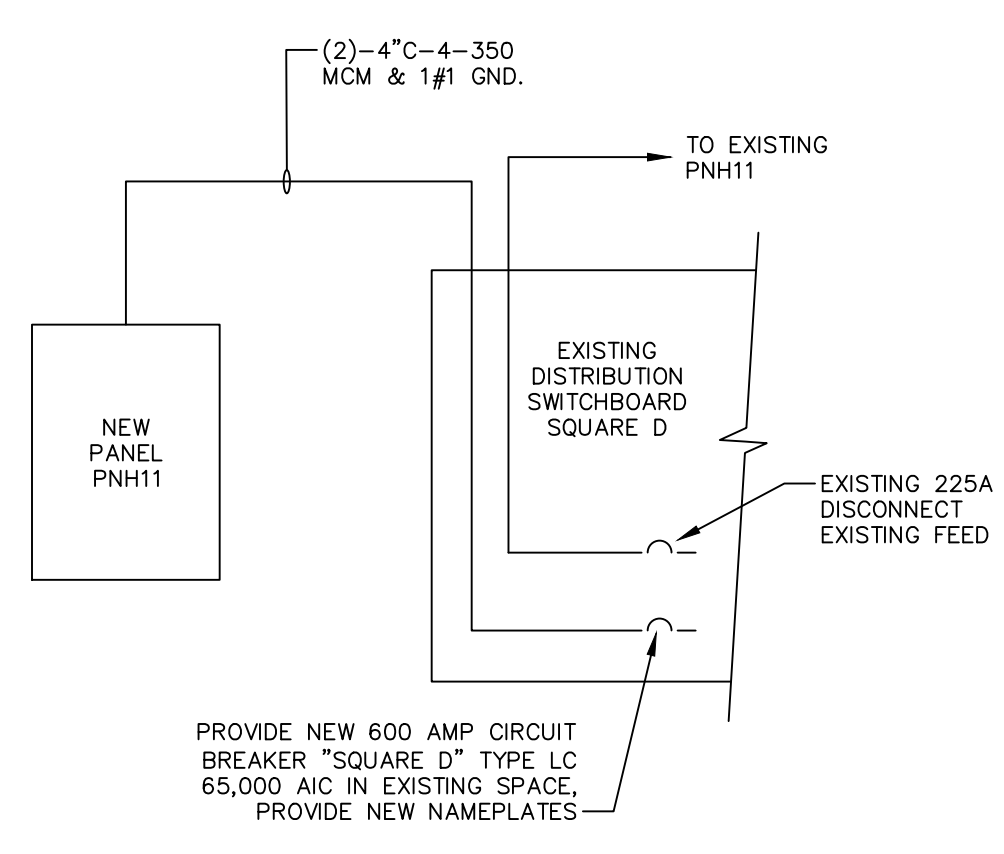


NOTE: DIMENSIONS TO BE VERIFIED IN FIELD WITH EQUIPMENT SHOP DRAWING AND APPROVED BY LIFT PROVIDER.

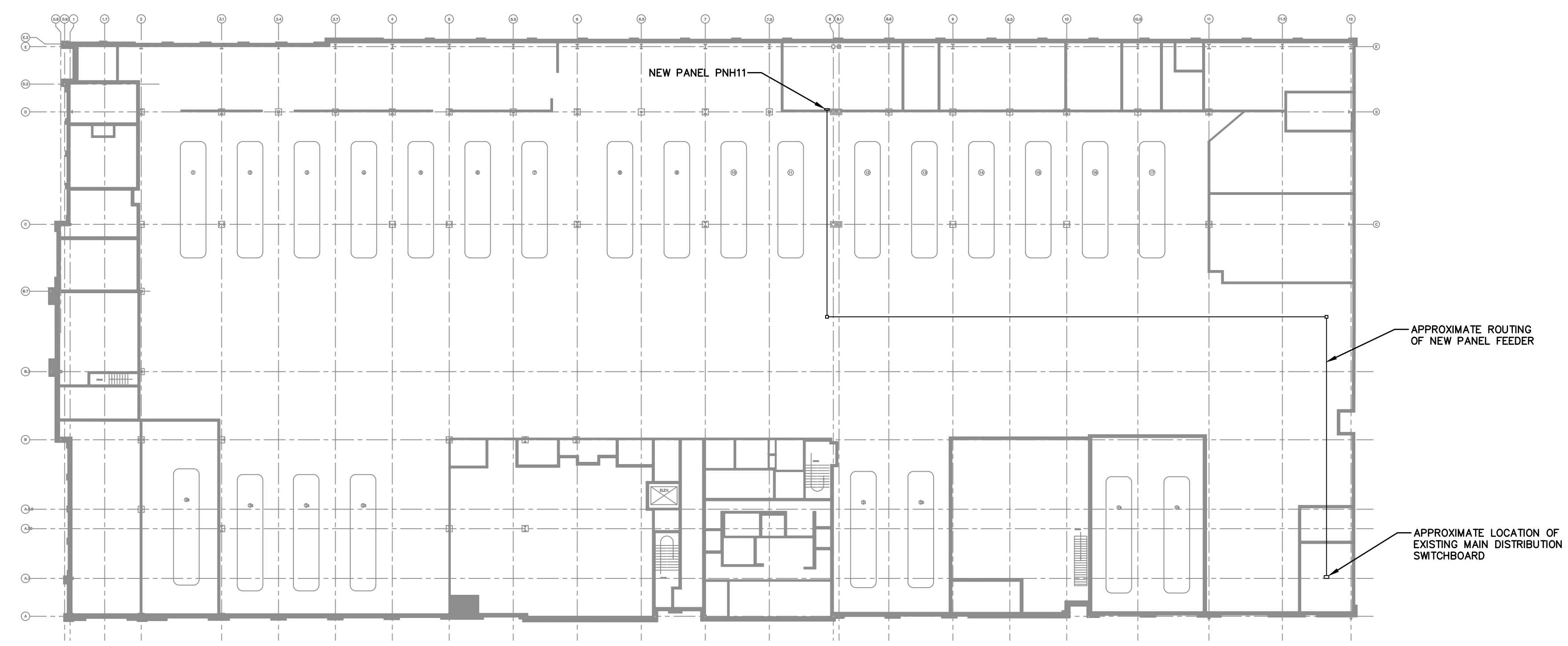
2 LIFT WIRING ONE LINE NOT TO SCALE



1 TYPICAL LIFT CONDUIT LH PLAN (RH PLAN SIMILAR) NOT TO SCALE



2 ONE LINE NOT TO SCALE



3 ROUTING OF PANEL FEEDER SCALE: 1"= 30'-0"

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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
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1.	8/30/2019	100% BID DOCUMENTS		

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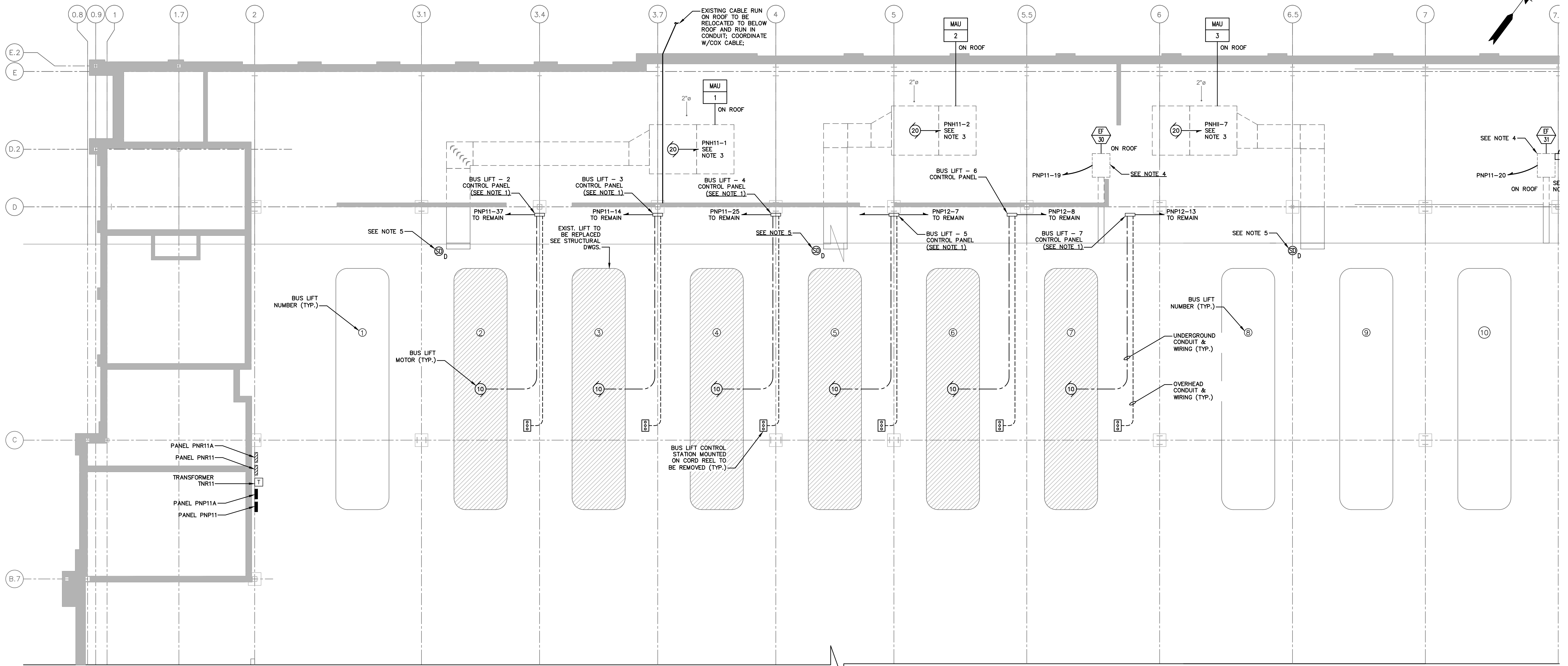
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SCALE: HORZ.: NOT TO SCALE VERT.: DATUM: HORZ.: VERT.: GRAPHIC SCALE

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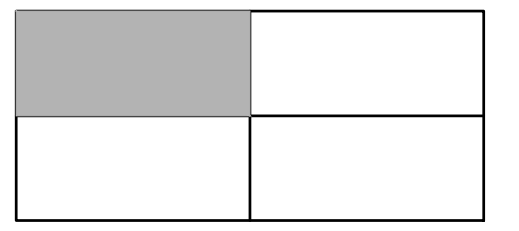
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 ELECTRICAL ONE-LINE DIAGRAMS
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020
E-002



1 PARTIAL FIRST FLOOR PLAN A
1/8" = 1'-0"

- NOTES:
- BUS LIFT CONTROL PANEL TO BE REMOVED AND REPLACED WITH NEW 6"x6"x4" DP JUNCTION BOX. MAINTAIN UNDERGROUND LIFT POWER FEED WIRING (3/4" 1#12 GND.) TO PANEL RACEWAY (3/4" C). ELECTRICAL CONTRACTOR SHALL REMOVE WIRING TO MOTOR AND HYDRAULIC & AIR LINES TO PIT RUN IN 3/4" AND 2" CONDUIT. CUT CONDUITS FLUSH WITH FLOOR AND FILL WITH CONCRETE.
 - NOT USED.
 - MAKE UP AIR UNITS MAU-1 THRU MAU-5 TO BE DISCONNECTED AND REMOVED. REMOVE CONDUIT AND WIRING COMPLETE TO PANEL PNH-11. PROVIDE NEW WIRING TO NEW PANEL PNH-11 AS INDICATED.
 - EF-30, EF-31, AND ACU-1 TO BE DISCONNECT AND REMOVED CONDUIT AND WIRING COMPLETE TO EXISTING PANEL PNH11. REWIRE TO NEW PANEL PNH11 AS INDICATED.
 - DUCT SMOKE DETECTOR TO BE REMOVED AND REPLACED NEW. MAINTAIN EXISTING FIRE ALARM SYSTEM LOOP WIRING. REMOVE CONDUIT AND WIRING TO MAU AND PROVIDE NEW WIRING FOR UNIT SHUT DOWN.



KEY PLAN

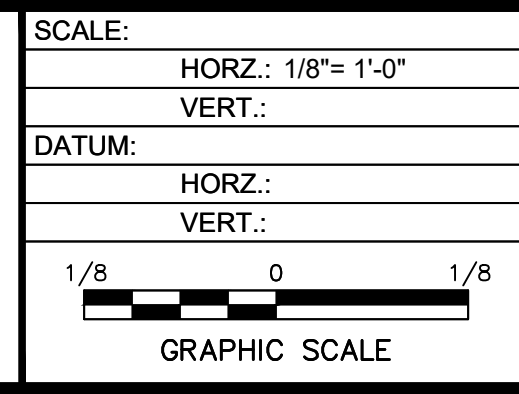
ISSUED FOR BID 02/10/2020

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 LAYER STATE:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
2.	2/10/2020	ISSUED FOR BID		
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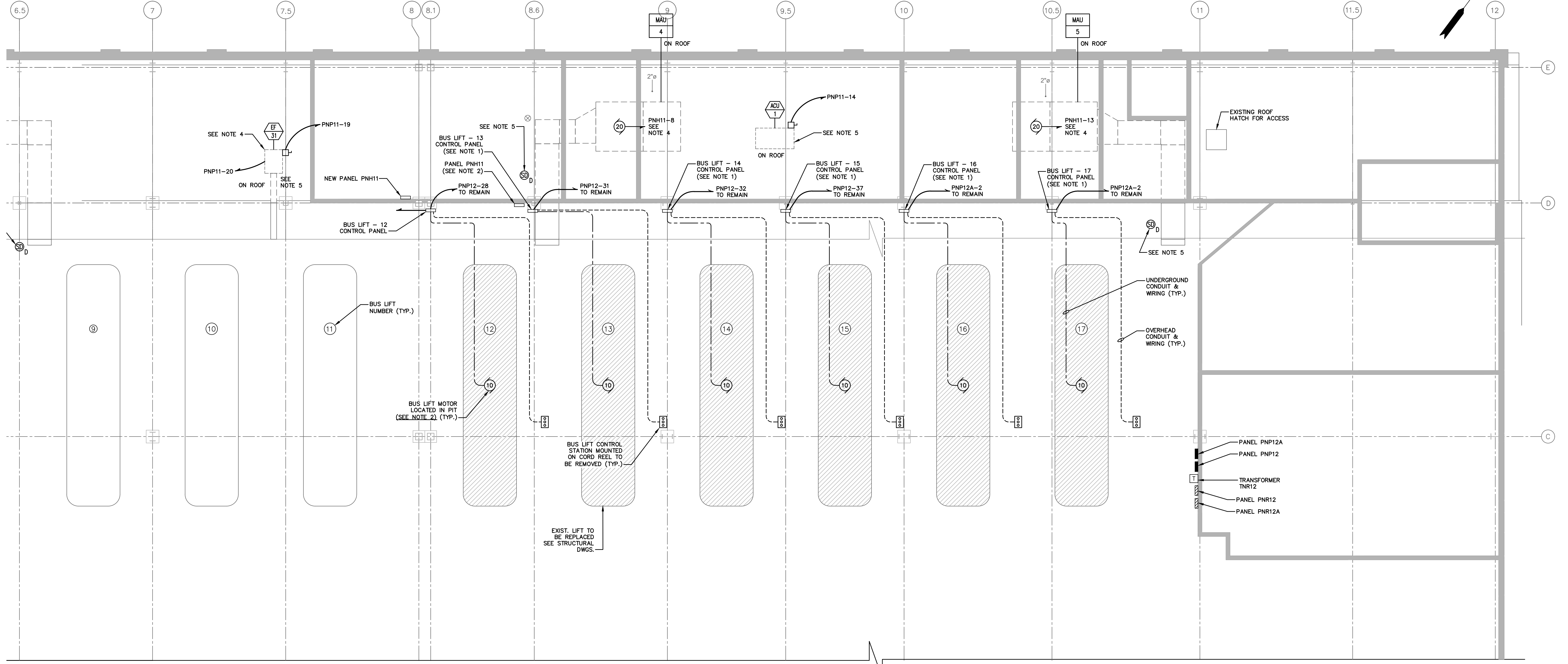
ELECTRICAL DEMOLITION PLAN NO. 1

750 ELMWOOD AVE - BUS LIFT REPLACEMENT

PROVIDENCE RHODE ISLAND

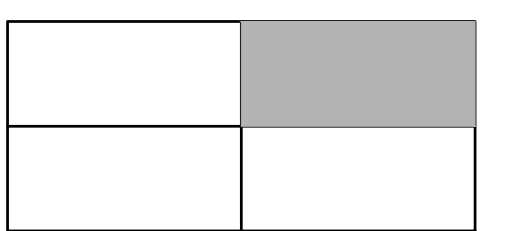
PROJ. No.: 20180433.A20
DATE: FEBRUARY 10, 2020

E-100



1 PARTIAL FIRST FLOOR PLAN B
1/8" = 1'-0"

- NOTES:**
- BUS LIFT CONTROL PANEL TO BE REMOVED AND REPLACED WITH NEW 6"x6"x4" DP JUNCTION BOX. MAINTAIN UNDERGROUND LIFT POWER FEED WIRING (3#12, 1#12 GND.) TO PANEL RACEWAY (3/4" C). ELECTRICAL CONTRACTOR SHALL REMOVE WIRING TO MOTOR AND HYDRAULIC & AIR LINES TO PIT RUN IN 3/4" AND 2" CONDUIT. CUT CONDUITS FLUSH WITH FLOOR AND FILL WITH CONCRETE.
 - PANEL PNH11 TO BE REMOVED AND REPLACED NEW.
 - MAKE UP AIR UNITS MAU-1 THRU MAU-5 TO BE DISCONNECTED AND REMOVED. REMOVE CONDUIT AND WIRING COMPLETE TO PANEL PNH-11. PROVIDE NEW WIRING TO NEW PANEL PNH-11 AS INDICATED.
 - EF-30, EF-31, AND ACU-1 TO BE DISCONNECT AND REMOVED CONDUIT AND WIRING COMPLETE TO EXISTING PANEL PNH11. REWIRE TO NEW PANEL PNH11 AS INDICATED.
 - DUCT SMOKE DETECTOR TO BE REMOVED AND REPLACED NEW. MAINTAIN EXISTING FIRE ALARM SYSTEM LOOP WIRING. REMOVE CONDUIT AND WIRING TO MAU AND PROVIDE NEW WIRING FOR UNIT SHUT DOWN.



KEY PLAN

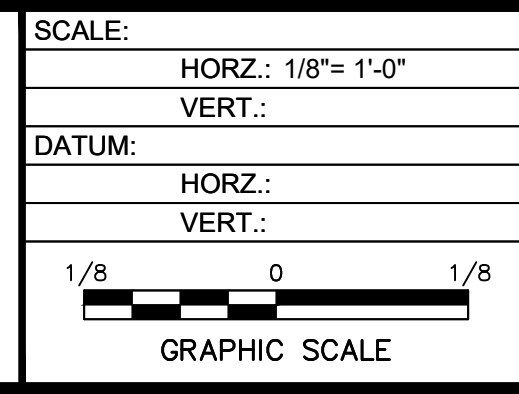
ISSUED FOR BID 02/10/2020

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 LAYER STATE:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
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1.	8/30/2019	100% BID DOCUMENTS		

SEAL

SEAL

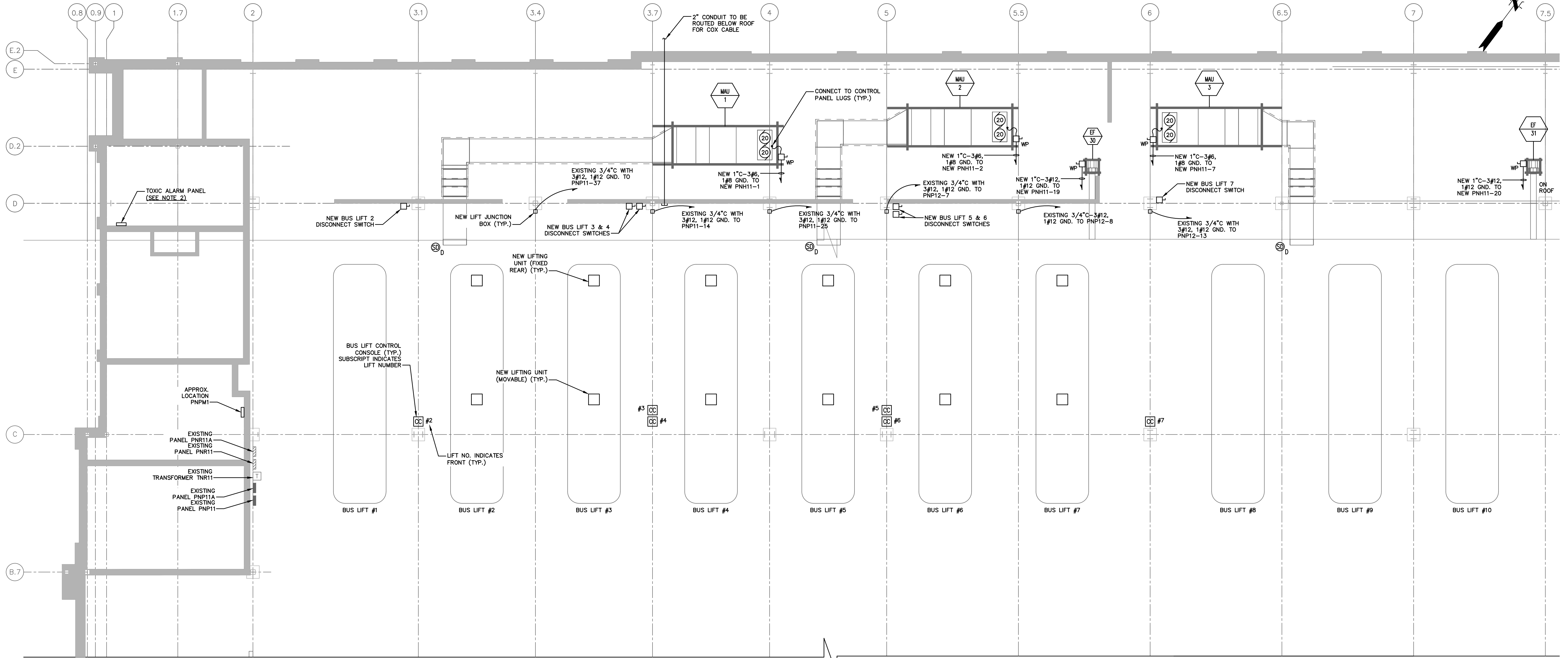


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 ELECTRICAL DEMOLITION PLAN NO. 2
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
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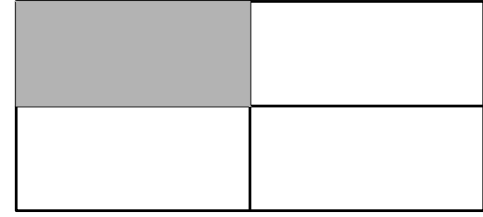
PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020
E-101

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 MS VIEW: LAYER STATE: Plotter: AUTOCAD PDF (GENERAL DOCUMENTATION) PC3 CTB File: FO.STB



1 PARTIAL FIRST FLOOR PLAN A
 1/8" = 1'-0"

- NOTES:**
- INTERCEPT EXISTING POWER FEED (3#12, 1#12 GND.-3/4") REMOVE EXISTING CONDUCTORS AND REPLACE WITH NEW FROM 3#10, 1#10 GND. TO EXISTING CIRCUIT BREAKER.
 - CONNECT WITH 3/4"-2#12, 1#12 GND. TO SPARE 120V CIRCUIT IN PANEL PNP11.



KEY PLAN

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No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
2.	2/10/2020	ISSUED FOR BID		
1.	8/30/2019	100% BID DOCUMENTS		

SEAL

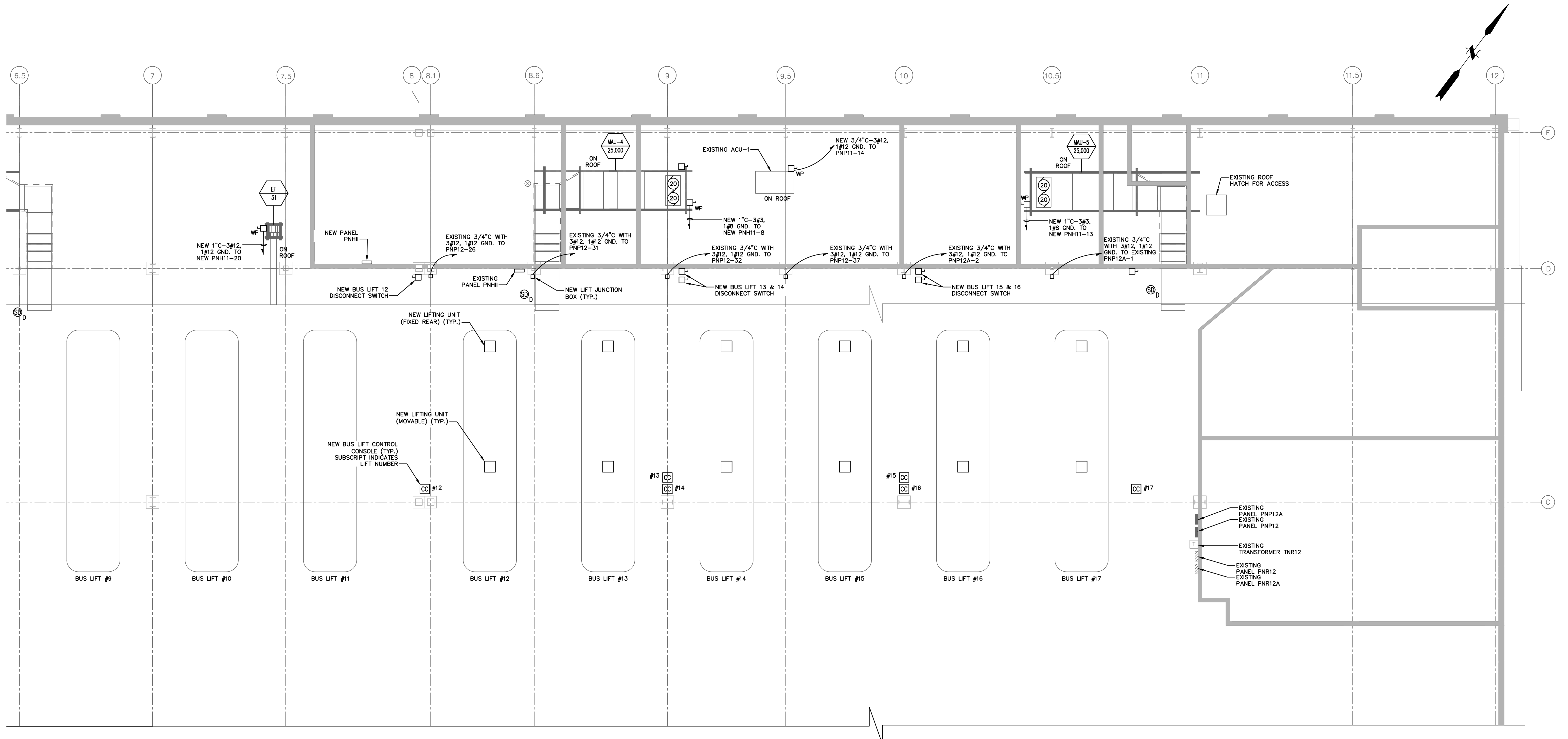
SEAL

SCALE:
 HORZ.: 1/8" = 1'-0"
 VERT.:
 DATUM:
 HORZ.:
 VERT.:
 1/8" 0 1/8"
 GRAPHIC SCALE

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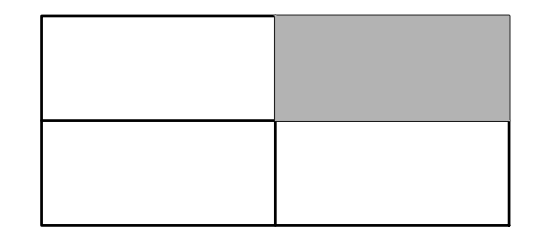
RHODE ISLAND PUBLIC TRANSIT AUTHORITY
 ELECTRICAL NEW WORK PLAN NO. 1
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020
E-102



1 PARTIAL FIRST FLOOR PLAN B
1/8" = 1'-0"

NOTES:
1. INTERCEPT EXISTING POWER FEED (3#12, 1#12 GND.-3/4"C) REMOVE EXISTING CONDUCTORS AND REPLACE WITH NEW FROM 3#10, 1#10 GND. TO EXISTING CIRCUIT BREAKER.



KEY PLAN

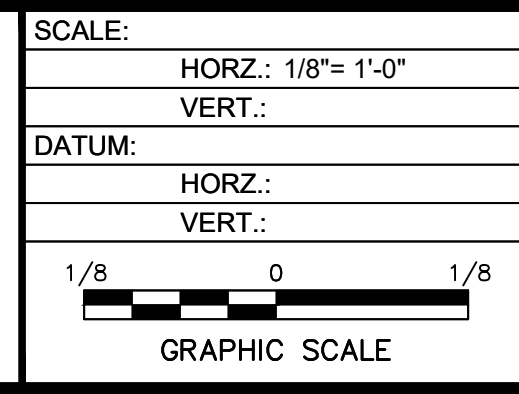
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1.	8/30/2019	100% BID DOCUMENTS		

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 ELECTRICAL NEW WORK PLAN NO. 2
 750 ELMWOOD AVE - BUS LIFT REPLACEMENT
 PROVIDENCE RHODE ISLAND

PROJ. No.: 20180433.A20
 DATE: FEBRUARY 10, 2020
E-103