

SECTION 00005 – ADDENDUM NUMBER 5

DATE: JANUARY 16, 2026

TO: ALL BIDDERS

**FROM: PERKINS & WILL
225 FRANKLIN STREET, SUITE 700
BOSTON, MA 02110**

RE: WORCESTER SOUTH DIVISION FIRE STATION, WORCESTER, MA

THIS ADDENDUM FORMS A PART OF THE CONTRACT AND MODIFIES THE ORIGINAL DOCUMENTS DATED DECEMBER 2025.

PART 1 - GENERAL

- 1.1** This addendum must be returned with plans and specifications (if not already returned) to have your deposit returned.
- 1.2** This addendum modifies, amends, and supplements the Contract Documents for the above referenced project. This addendum is hereby made a part of the Contract Documents by reference and shall be as binding as though inserted in locations designated hereunder.
- 1.3** Each general bidder shall be responsible for notifying all his non-filed sub-bidders and suppliers of the content of this addendum. No claim for additional compensation will be considered because of lack of knowledge of changes or modifications contained in this addenda.
- 1.4** Questions or requests for clarification shall be in writing, addressed to Jeremy C. Flansburg, Assistant Purchasing Director at **PURCHASING DEPARTMENT**, and be sent flansburgjc@worcesterma.gov. Please include your name, phone number, and e-mail.
- 1.5** Part 2 of this addendum indicates revisions to the Project Manual.
- 1.6** Part 3 of this addendum indicates revisions to the Drawings.
- 1.7** Part 4 of this addendum indicates clarification to Contractors Questions.

PART 2 - SPECIFICATION

2.1 SECTION 001000 – INVITATION TO BID

Page 2: DELETE: SEALED FILED TRADE-BIDS for the NEW WORCESTER SOUTH DIVISION FIRE STATION PROJECT will be received at the Department of Public Facilities, 50 Officer Manny Familia Way (formerly Skyline Drive), Worcester, MA 01605 no later than 10:00 a.m., Wednesday, January 28, 2025.

And Insert:

SEALED FILED TRADE-BIDS for the NEW WORCESTER SOUTH DIVISION FIRE STATION PROJECT will be received at the Purchasing Department, 455 Main Street, Worcester, MA 01605 no later than 10:00 a.m.,

Wednesday, January 28, 2025.

2.2 SECTION 00 16 00 00 – TRADE CONTRACTOR BID FORM

DELETE section in its entirety and **REPLACE** with the updated Section 00 16 00 attached

2.3 SECTION 01 22 00 UNIT PRICE

DELETE section in its entirety and **REPLACE** with the updated Section 01 22 00 attached

2.4 SECTION 26 00 01 – ELECTRICAL WORK

DELETE section in its entirety and **REPLACE** with the updated Section 26 00 01 attached

2.5 SECTION 26 09 13 – ELECTRICAL POWER MONITORING SYSTEM

DELETE section in its entirety and **REPLACE** with the updated Section 26 09 13 attached

2.6 SECTION 26 12 19 – PAD MOUNTED, LIQUID FILLED, MEDIUM-VOLTAGE TRANSFORMERS

DELETE section in its entirety and **REPLACE** with the updated Section 26 12 19 attached

2.7 SECTION 26 13 23 – MEDIUM-VOLTAGE, METAL-ENCLOSED SWITCHGEAR
DELETE section in its entirety and **REPLACE** with the updated Section 26 13 23 attached

2.8 SECTION 26 24 13 – SWITCHBOARDS

DELETE section in its entirety and **REPLACE** with the updated Section 26 24 13 attached

2.9 SECTION 26 32 13 – DIESEL EMERGENCY ENGINE GENERATORS

DELETE section in its entirety and **REPLACE** with the updated Section 26 32 13 attached

2.10 SECTION 26 36 00 – TRANSFER SWITCHES

ADD section 26 36 00 as part of Project Manual VOL 2 after Section 26 32 13 Diesel Emergency Engine Generator.

2.11 VOL 3 – APPENDIX

ADD Appendix D - Purvis system cutsheets and matrix after Appendix C.

PART 3 - DRAWINGS

3.1 DELETE Drawing M08.02 and **REPLACE** with revised drawing M08.02

3.2 DELETE Drawing E01.01 and **REPLACE** with revised drawing E01.01

3.3 DELETE Drawing E03.00 and **REPLACE** with revised drawing E03.00

- 3.4** **DELETE** Drawing E05.01 and **REPLACE** with revised drawing E05.01
- 3.5** **DELETE** Drawing E07.00 and **REPLACE** with revised drawing E07.00
- 3.6** **DELETE** Drawing E08.03 and **REPLACE** with revised drawing E08.03
- 3.7** **DELETE** Drawing E08.04 and **REPLACE** with revised drawing E08.04
- 3.8** **DELETE** Drawing E08.05 and **REPLACE** with revised drawing E08.05
- 3.9** **DELETE** Drawing E09.01 and **REPLACE** with revised drawing E09.01
- 3.10** **DELETE** Drawing E09.03 and **REPLACE** with revised drawing E09.03

PART 4 - CONTRACTOR QUESTIONS

- 4.1** Q: Section 23 09 23-26, Paragraph 2.9 requires a rack-mounted BMS server. An existing server currently hosts the City-wide Alerton system and graphics. Is it acceptable to utilize the existing server and software for this project in lieu of providing a new rack-mounted BMS server?
A: City of Worcester Department of IT operations have confirmed via email it is acceptable to utilize the existing virtual server and software for the project in lieu of providing a new rack mounted BMS server. This request does not align with the design drawings and specifications; however, based on the Owner's directive, the substitution/replacement may proceed as instructed. Please ensure all related trades are coordinated and any cost/schedule implications are addressed per contract requirements.
- 4.2** Q: Section 23 09 23-22, Paragraph 2.5 defines requirements for DDC controllers. To align with City of Worcester standard controllers, is the use of IP-based controllers without integral hardware override switches acceptable?
A: See forthcoming addendum for response and updated documentations.
- 4.3** Q: Section 23 09 23-42, Paragraph 2.20.B specifies 4-wire thermistor temperature sensors with a 4–20 mA output. To align with City of Worcester standards, is the use of a 2-wire thermistor sensor acceptable?
A: City of Worcester Department of facilities have confirmed via email the use of 2 wire 10k thermistor is acceptable. This request does not align with the design drawings and specifications; however, based on the Owner's directive, the substitution/replacement may proceed as instructed. Please ensure all related trades are coordinated and any cost/schedule implications are addressed per contract requirements.
- 4.4** Q: Please provide specs for transfer switch for the generator.
A: See addendum #5 for transfer switch specifications.
- 4.5** Q: With respect to the c.149 or c.149 A alternate delivery method with the Construction Manager at risk do you expect the electrical subcontractor to furnish or warrant any design services, carry errors and omission liability coverage, or carry any financial risk related to the design?
A: See Section General Conditions Article XIV and Section 00 72 27 INSURANCE REQUIREMENTS for insurance requirements..
- 4.6** Q: Please advise if Owner or Contractor/CM will buy the builder's risk property insurance for this project. Also, can you confirm that trade contractors/subcontractors of all tiers will be named insureds under the policy per widespread industry practice? Finally, can you tell us what the basic deductible will be under the policy and who will be required to pay it if an accident happens-1) Owner, 2) Contractor/CM, 3) Trade Contractor/Subcontractor?"
A: For this project, the construction manager (CM) will be procuring the Builders Risk Insurance Policy. Under this policy, the Owner, Architect, CM, and all trade contractors / subcontractors

will be listed as Additional Named insureds on the policy. The deductible is to be handled as noted in section 007227 K.2 Insurance requirements.

- 4.7** Q: With respect to the project bid construction schedule and the ongoing uncontrollable impacts to the supply chain, shortages of products and long lead times, we assume the Construction Manager and/or General Contractor has or shall take these long lead times into account when providing their CPM schedules to the Owner, to confirm the as-bid electrical work can be performed within the contract duration.
A: See addendum #4.
- 4.8** Q: Some designs require equipment with long lead times. Examples of long lead equipment are Switchgear, Transformers, Generators, VFD's, Metering, MCC's, and the electronic components of many telecom systems. Because there are no remedies in the bid document at this time, financial or otherwise, to correct potential long lead times, please confirm the Electrical Engineer has considered equipment lead times when designing the most available equipment and specified products and has received confirmation of product timely availability to meet the contract end date.
A: See addendum #4.
- 4.9** Q: Please confirm whether Davis-Bacon wage rates are applicable to this project. Based on our current understanding, they do not apply. If Davis-Bacon wage rates are required, please provide the applicable and updated Davis-Bacon wage determinations so that we can ensure full compliance.
A: Davis-Bacon wage rates are not applicable to this project.
- 4.10** Q: Will the City be waving all permit fees for this project?
A: All permit fees will be waived for this project.
- 4.11** Q: The Instructions to Bidders states that bids shall be submitted to the Owner at the place state in the Advertisement for Bids. However, the specifications do not contain the Advertisement for Bids nor is this information posted on the City of Worcester website. Please advise if the bids are to be submitted to the City of Worcester Purchasing Division.
A: See addendum #5.

List of Attachments

1. Revised Specification Section 00 16 00
2. Revised Specification Section 01 22 00
3. Revised Specification Section 26 00 01
4. Revised Specification Section 26 09 13
5. Revised Specification Section 26 12 19
6. Revised Specification Section 26 13 23
7. Revised Specification Section 26 24 13
8. Revised Specification Section 26 32 13
9. New Specification Section 26 36 00
10. Revised Drawing M08.02
11. Revised Drawing E01.01
12. Revised Drawing E03.00
13. Revised Drawing E05.01
14. Revised Drawing E07.00

- 15. Revised Drawing E08.03
- 16. Revised Drawing E08.04
- 17. Revised Drawing E08.05
- 18. Revised Drawing E09.01
- 19. Revised Drawing E09.03

END OF ADDENDUM NUMBER 5

TRADE CONTRACTOR BID FORM

Company Name _____,

TO ALL TRADE CONTRACTOR BIDDERS EXCEPT THOSE EXCLUDED:

A. TRADE: _____,

Specified in Section (s): _____,
_____,

(Bidder: Enter above the name of the trade for which you are bidding and list ALL the specification section or sections applicable to that trade as they are listed in the Table of Contents of the Specifications; for example, "Painting, Section 09 91 00;" "Glazing, Section 08 80 00;" "Electrical Work, all Division 26.

The undersigned proposes to furnish all labor and materials are required for completing all the work of the trade identified above, for Addition and Renovations to DCU center, located in Worcester, Massachusetts, in accordance with the Contract Documents, including Drawings and Specifications.

The proposed Contract Price is

_____ dollars (\$_____)

Alternates: [Enter a dollar value wither in the "add" or "subtract" line. If the Alternate will not change the proposed Contract Price, enter \$0 or "NC" ("no change") in the "add" line.]

B. For Alternate 1, _____,

ADD _____ dollars \$_____)

SUBTRACT _____ dollars \$_____)

ADDENDA: This trade contractor bid includes the following Addenda:

<u>Number</u>	<u>Date</u>	<u>Number</u>	<u>Date</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

C. **IMPORTANT INFORMATION:** Because this is a CM at Risk Project **All Trade Contractors** must include their Bid price the cost of their providing payment and performance bonds in the full amount of their Bid, including all alternates. All Trade

Contractors awarded contracts on this Project are required by law to provide full payment and performance bonds at their own expense.

D. **EXECUTION OF CONTRACT; BONDS; INSURANCE:** The undersigned agrees, if selected as a Trade Contractor, to execute with the Construction Manager (hereafter sometimes referred to as the “CM at Risk” or the “Contractor”), a trade Contractor Agreement in accordance with the terms of this bid and applicable law within ten (10) days, Saturdays, Sundays and legal holidays excluded, after presentation thereof by the Construction Manager. If the undersigned further agrees to furnish a performance bond and payment bond in the full amount of the trade contract amount from a surety company licensed to do business in the commonwealth and whose name appears on the United States Treasury Department Circulation 570; provided that the bonds are subject to section (3) of section 44F of chapter 149 and (b) a Certificate of Insurance evidencing workers’ compensation, public liability or property damage insurance of the type and in limits required to be furnished to the Awarding Authority by the Construction manager as required by law.

To the extent provided by law, if the undersigned is bidding on the work of a sub-trade for which bidders have not been prequalified by the awarding authority, the undersigned agrees, if requested to do so by the Construction Manager, to furnish a performance bond and also a labor and materials or payment bond, each of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, and each in the sum of one hundred percent (100%) of the sub trade subcontract Price, the premiums for which shall be paid by the Construction Manager and be included in the Contract Price for the General Contract.

E. **TRADE CONTRACTOR SUB-TRADE SUB-BIDDER LISTING:** The names of all persons, firms, and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of work for which the provisions of the Section of the Specifications for this sub-trade require a listing in this paragraph (including the undersigned if customarily furnished by persons on his own payroll and in the absence of a contrary provision in the specifications), and the bid price for each such class of work or part thereof as follows:

<u>NAME</u>	<u>CLASS OF WORK</u>	<u>BID PRICE</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

(Do not give bid price for any class or part thereof furnished by undersigned.)

(The names of all sub-trade subcontractors to be used if awarded the trade contract and each sub-trade contract sum shall be identified above)

By submission of the Bid the Trade Contractor certifies that it has prequalified each of the sub-trade subcontractors listed above using criteria similar to the criteria for the prequalification of Trade Contractors.

By submission of this Bid the Trade Contractor certifies that the Trade Contractor certifies that the Trade Contractor will perform the complete trade work with employees on his own payroll, except for work customarily performed by the sub-trade subcontractors within the trade. Trade Contractor further certifies that this Bid provides the names of all sub-trade subcontractors to be used and each sub-trade contract sum.

- F. The undersigned agrees that the above list of bids to the undersigned represents *bona fide* bids based on the plans, specifications and addenda, and that, if the undersigned is awarded the contract, the persons, firms, corporations listed above will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.
- G. UNIT PRICES (*This Provision applies to Trade Contractor Sub-Bidders, for unit prices applicable to work of other trades enter N/A in the “Add and Deduct” column.*) Should certain additional classes of work be required or should the quantities of certain classes of work be increased or decreased from those on which this sub-bid is to be based, by order or approval of the Architect, the undersigned agrees that the Unit Prices set forth below will be the basis of payment to the subcontractor or credit to the awarding authority for such addition, increase, or decrease of the Work. The undersigned agrees that the Unit Prices given represent the exact amount per unit to be paid to the subcontractor (in the case of additions or increases) or to be refunded to the Awarding Authority (in the case of decreases), and that no additional adjustment will be requested or allowed for overhead, profit, insurance, compensation insurance, or other direct or indirect expenses of the subcontractor. The awarding authority shall have the right to reject any or all proposed Unit Prices at any time prior to the signing the Agreement. In which case the cost of extra work shall be as determined by one of the other methods set forth in the General Conditions.
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SCHEDULE OF UNIT PRICES

TRADE CONTRACT

Unit Price Item No.	Spec Section	Description	<u>Quantity to be INCLUDED in Base Bid</u>	Unit of Measure	Add and Deduct Amount
A.	03 54 16	Self-leveling – 1/4" - 1/2" average thickness	<u>Cost per SF for 1,000 SF</u>	<u>2,500 1 SF</u>	
B.	03 54 16	Self-leveling – 1/2" – 3/4" average thickness	<u>Cost per SF for 1,000 SF</u>	<u>4,000 1 SF</u>	
C.	03 54 16	Self-leveling – 3/4" - 1" average thickness	<u>Cost per SF for 1,000 SF</u>	<u>4,500 1 SF</u>	
D.	26 51 00	Illuminated Exit Signs		Each	
E.	09 05 61.13	Moisture Vapor Emission Control System	<u>Cost per SF for 1,000 SF</u>	<u>1 SF</u>	

- H. The undersigned further agrees to be bound to the Construction Manager by the terms of the plans, drawings, specifications (including all General Conditions), and addenda, and to assume toward Construction Manager all the obligations and responsibilities that the Construction Manager, by those documents, assumes toward the Owner.
- I. The undersigned offers the following information as evidence of his or her qualifications to perform the work as bid upon, according to all the requirements of the plans, drawings and specifications:
1. Have been in business under present business name _____ years.
 2. Ever failed to complete any work awarded? (If yes, briefly explain)

3. List one or more recent buildings with names of general contractor and architect on which you served as subcontractor and performed work of similar character to the work required for this project:

BUILDING	ARCHITECT	GENERAL CONTRACTOR	AMOUNT OF CONTRACT
_____	_____	_____	_____
_____	_____	_____	_____

4. Bank Reference: _____, _____, _____

Failure to meet trade contractor qualification requirements in the specification Sections listed in this Trade Contractor Bid Form, or failure to provide sufficient information in this Paragraph 1 to substantiate the required qualifications, may, at the sole discretion of the Awarding Authority, be deemed sufficient cause for rejection of any bid. The bidder expressly agrees that the judgment of the Awarding Authority on the matter of qualification is final.

J. CERTIFICATIONS

The undersigned hereby certifies that the Trade Contractor will perform the complete trade contract work with employees on its own payroll, except for work customarily performed by sub-trade subcontractors within the trade as listed above. Trade Contractor further certifies that this Bid provides the names of all sub-trade subcontractors to be used and each sub-trade contract sum.

The undersigned hereby certifies that all sub-trade subcontractors named in this bid form have been prequalified by the trade contractor using criteria similar to the contractors.

The undersigned further certifies that it shall comply with the prevailing wage law set forth in M.G.L. c. 149, §§26 & 27 and pay wages no less than those set forth in the wage rate tables for the Project. The undersigned further certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work; that all employees to be employed at the worksite will have successfully completed a course in safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that will comply fully with all laws and regulations applicable to awards of subcontracts subject to Chapter 149A of the General Laws.

The undersigned further certifies under penalties of perjury that this Bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in the subsection the word “person” shall mean any natural person, joint venture, partnership, corporation or other business or legal entity. The undersigned also certifies that he or she

(or, if he or she is the authorized representative of the company, the company) is the only person interested in this Bid; that it is made without any connection with any other person making any other submission for the same work; that no person acting for, or employed by, the Commonwealth of Massachusetts or the City of Worcester is directly or indirectly interested in the Bid or any subsequent proposal, or in any contract which may be made under it, or in expected profits to arise therefrom; that the undersigned Bidder has not influenced or attempted to influence any other person or corporation to file a Bid or any subsequent proposal or to refrain from doing so or to influence the terms of the Bid or any subsequent proposal of any other person or corporation; and that this submission is made in good faith without collusion or connection with any other person applying for the same work.

The undersigned certifies that if awarded this work shall comply with all federal and state laws, rules and regulations promoting fair employment practices or prohibiting employment discrimination and unfair labor practices and shall not discriminate in the hiring of any applicant for employment nor shall any qualified employee be demoted, discharged or otherwise subject to discrimination in the tenure, position, promotional opportunities, wages, benefits or terms and conditions of their employment because of race, color, national origin, ancestry, age, sex, religion, disability, handicap, sexual orientation or for exercising any rights afforded by law. The undersigned commits to purchasing supplies and services from certified minority and women owned businesses, small businesses or businesses owned by socially or economically disadvantaged persons or persons with disabilities.

The undersigned further certifies pursuant to M.G.L. c.149A, §8(g)(8) and M.G.L. 151A, §19A, I, that Bidder has filed all state and tax returns and paid all taxes as required by law and has complied with all state laws pertaining to contributions to the unemployment compensation fund and to payments in lieu of contributions.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of section twenty-nine F of chapter twenty-nine or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation [promulgated there under. The undersigned further certifies under pain and penalties perjury that it is not presently debarred from doing public work under any applicable federal law.

- K. The undersigned hereby agrees that this bid shall be valid for a period of 30 days, Saturdays, Sundays and legal holidays excluded, after the date designated for opening of the Bids.
- L. ATTACHMENTS

AS LISTED IN THE INVITATION TO BID – Specification Section 001000

- **INFORMATIONAL SHEET (Form in Section 3.3)**
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- **NON-COLLUSION AFFIDAVIT (Form in Section 3.3)**
- **AFFIDAVIT OF COMPLIANCE (Form in Section 3.3)**
- **AFFIDAVIT OF PREVAILING WAGE COMPLIANCE (Form in Section 3.3)**
- **COMPLIANCE WITH THE RESPONSIBLE EMPLOYER ORDINANCE (Specification Section 009500)**
- **TAX PAYMENT CERTIFICATE (Form in Specification Section 008500)**

Acknowledgement of Addenda. By signing below, the interested Trade Contractor acknowledges receipt of the addenda listed by Trade Contractor Bid Form.

Authorized to sign: This form must be signed by an officer of the firm or an individual so authorized by an officer of the firm who has personal knowledge regarding the information contained herein.

SIGNED UNDER THE PAINS AND PENALTIES OF PERJURY:

Signature: _____,

Print Name: _____,

Title: _____,

Firm Name: _____,

Firm Address: _____,

_____,

Phone No: _____,

Date: _____,

Project Name: _____,

SECTION 01 22 00

UNIT PRICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

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

1.3 PROCEDURES

- A. Unit prices include materials, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

- A. Refer to individual Sections of Specifications for the descriptions of units of work where the establishment of unit prices is required; the methods of measurement and pricing are specified therein.

3.2 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Self-leveling – 1/4" to 1/2" average thickness

1. Description: Furnish and install self-leveling underlayment per requirements of 03 54 16 Hydraulic Cement Underlayment. - Average thickness 1/4" to 1/2", in accordance with Specification Section 09 65 19 "Resilient Tile Flooring"
2. Unit of Measurement: SF for 1,000 SF
- B. Unit Price No. 2: Self-leveling – 1/2" to 3/4" average thickness
 1. Description: Furnish and install self-leveling underlayment per requirements of 03 54 16 Hydraulic Cement Underlayment. - Average thickness 1/2" to 3/4", in accordance with Specification Section 09 65 19 "Resilient Tile Flooring"
 2. Unit of Measurement: SF for 1,000 SF
- C. Unit Price No. 3: Self-leveling – 3/4" to 1" average thickness
 1. Description: Furnish and install self-leveling underlayment per requirements of 03 54 16 Hydraulic Cement Underlayment. - Average thickness 3/4" to 1", in accordance with Specification Section 09 65 19 "Resilient Tile Flooring"
 2. Unit of Measurement: SF for 1,000 SF
- D. Unit Price No. 4: Illuminated Exit Sign
 1. Description: Provide illuminated exit sign, including 75 feet of conductor and raceway, according to Section 26 51 00 "Interior Lighting".
 2. Unit of Measurements: Each.
- E. Unit Price No. 5: Moisture Vapor Emission Control System
 1. Description: Furnish and install moisture vapor emission control system per requirements of 09 05 61.13 Moisture Vapor Emission Control System,
 2. Unit of Measurement: SF for 1,000 SF.

END OF SECTION

SECTION 26 00 01

ELECTRICAL WORK

(Trade Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Time, Manner and Requirements for Submitting Trade Bids:
 1. Trade bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Owner at a time and place as stipulated in the "INSTRUCTIONS TO BIDDERS".
 - a. The following should appear on the upper left hand corner of the envelope:
 - b. NAME OF TRADE BIDDER: (Insert name of trade bidder)
 - c. TRADE BID FOR SECTION: 26 00 01 – ELECTRICAL WORK
 - d. Each trade bid submitted for work under this Section shall be on forms furnished by the Owner as required by Section 8 of Chapter 149A of the General Laws, as amended. Trade bid forms may be obtained at the office of the Owner.
 2. Trade bids filed with the Owner shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the City of Worcester in the amount of five percent of the trade bid. A trade bid accompanied by any other form of bid deposit than those specified will be rejected.
- C. Trade Sub-Bid Requirements:
 1. Section 28 31 11 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM for fire alarm system work.
 2. DIVISION 27 – COMMUNICATIONS for communications infrastructure systems work.
 3. Section 27 41 00 – CATV DISTRIBUTION SYSTEM for Audiovisual system work.
 4. Section 28 00 00 – ELECTRONIC SECURITY GENERAL REQUIREMENTS for Security system work.
 5. Section 26 41 13 – LIGHTNING PROTECTION FOR STRUCTURES for lightning protection work.
- D. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:

1. 01-GENERAL Series
2. 26-ELECTRICAL Series

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. All Work of the following sections:
 - a. 26-ELECTRICAL sections
 - b. Section 270000 - Communications Systems.
 - c. Section 280000 - Security Systems.
 2. Firestopping for the Work of this Section, including cutting penetrations and firestopping; complying with requirements specified in Section 07 84 13 - PENETRATION FIRESTOPPING.
 3. Core drilling for the Work of this Section.
 4. Certified seismic restraints to meet the Commonwealth of Massachusetts Building Code applicable at the time the building permit is issued.
 5. Coordination drawings and record drawings and similar requirements.
 6. CAMIS excel spreadsheet data collection for Equipment Template and PM Procedure tabs as described in Section 01 77 00 - CLOSEOUT PROCEDURES
 7. BIM modeling as specified in this Section and in Section 01 31 06 - COORDINATION DRAWINGS.
 8. Including Pre-Purchase of equipment in the following sections:
 - a. Section 26 12 19 - Pad-mounted, Liquid-Filled, Medium-Voltage Transformers
 - b. Section 26 13 23 - Medium-Voltage Metal-Enclosed Switchgear
 - c. Section 26 24 13 - Switchboards
 - d. Section 26 32 13 - Diesel Emergency Engine Generators
 - e. Section 26 36 00 - Transfer Switches

- a. Power connections for water heaters.
- 7. Section 23 00 01 - HEATING, VENTILATING AND AIR CONDITIONING:
 - a. Power connections for DDC control panels, pumps, fans, electric unit heaters.
 - b. Magnetic starters.
- D. Items to Be Furnished Only: Furnish the following items for installation by the designated Sections:
 - 1. Section 03 30 00 - CAST-IN-PLACE CONCRETE:
 - a. Lintels, sleeves, anchors, inserts, plates and similar items for electrical systems.
 - 2. Section 04 20 00 - UNIT MASONRY:
 - a. Elevator rail bracket inserts.
 - b. Access doors in masonry openings.
 - 3. Section 09 29 00 - GYPSUM BOARD ASSEMBLIES:
 - a. Access doors in gypsum board assemblies.
 - 4. Section 09 30 00 - TILING:
 - a. Access doors in tile.
 - 5. Section 09 51 13 - ACOUSTICAL PANEL CEILINGS:
 - a. Access doors in acoustical tile.
 - 6. Section 23 00 01 - HEATING, VENTILATING AND AIR CONDITIONING:
 - a. Duct smoke detectors and sampling tubes.
- E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for interior concrete equipment pads and installation of backboxes and conduit for electrical devices and light fixtures.
 - 2. Section 05 12 00 - STRUCTURAL STEEL FRAMING for structural supports necessary to distribute loading from equipment to roof or floor.
 - 3. Section 06 10 00 - ROUGH CARPENTRY for plywood packing panels.
 - 4. Section 08 71 00 - DOOR HARDWARE for coordination with electrified door hardware.
 - 5. Section 09 29 00 - GYPSUM BOARD ASSEMBLIES for coordination with gypsum ceilings.
 - 6. Section 09 51 13 - ACOUSTICAL PANEL CEILINGS for coordination with acoustical ceilings.
 - 7. Section 23 00 01 - HEATING, VENTILATING AND AIR CONDITIONING for coordination with HVAC piping and ductwork, motors, and DDC wiring except 120 VAC power to control panel as indicated on the Drawings
 - 8. Section 31 00 00 - EARTHWORK for excavation and backfilling for underground work.
- F. The Electrical Trade Contractor shall be responsible for filing all documents, ~~payment of all fees~~, and securing of all inspections and approvals necessary for the electrical work.
- G. ~~The Electrical Trade Contractor shall carry in the bid price all Utility Company and Municipal backcharges for all materials furnished and work performed by them in~~

~~conjunction with this Contract and pay same to the respective agency upon demand. The Electrical Trade Contractor shall not be entitled to additional compensation after the submittal of his bid price should he fail, for any reason, to obtain the total backcharge costs to be incurred by the local utility companies or municipal agencies.~~

END OF SECTION

SECTION 26 09 13

ELECTRICAL POWER MONITORING SYSTEM

(Part of Work Section 26 00 01 – ELECTRICAL, Trade Bid Required)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following for monitoring and control of electrical power system:
1. PC-based server hardware and software.
 2. Application software for monitoring and trending of electrical parameters.
 3. Communication network components and interface modules for Modbus TCP/IP and, where required, RS-485 Modbus RTU data transmission protocols.
- B. Related Requirements:
1. Section 262413 "Switchboards".
 2. Section 262416 "Panelboards".
 3. Section 271500 "Communications Horizontal Cabling".

1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- C. HTML: Hypertext markup language.
- D. I/O: Input/output.
- E. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.

- F. LAN: Local area network; sometimes plural as "LANs."
- G. LCD: Liquid crystal display.
- H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- I. Modbus TCP/IP: An open protocol for exchange of process data.
- J. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- K. PC: Personal computer; sometimes plural as "PCs."
- L. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- M. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.
- N. RS-485: A TIA standard for multipoint communications using two twisted-pairs.
- O. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- P. THD: Total harmonic distortion.
- Q. UPS: Uninterruptible power supply; used both in singular and plural context.
- R. WAN: Wide area network.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
- B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
 - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data

- gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
 5. UPS sizing calculations for workstation.
 6. Surge Suppressors: Data for each device used and where applied.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.
- C. Other Informational Submittals:
 1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Operating and applications software documentation.
 2. Software licenses.
 3. Software service agreement.
 4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
 5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
- B. Software and Firmware Operational Documentation:
 1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
 2. Software operating and upgrade manuals.
 3. Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.

4. Device address list and the set point of each device and operator option, as set in applications software.
 5. Graphic file and printout of graphic screens and related icons, with legend.
- C. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or power monitoring and control revisions.
- D. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Addressable Relays: One for every 10 installed. Furnish at least one of each type.
 2. Data Line Surge Suppressors: One for every 10 of each type installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 COORDINATION

- A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
1. Match components and interconnections for optimum performance of specified functions.
- B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.10 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Eaton Corporation; Cutler-Hammer products.
 - 2. Rockwell Automation, Inc.; Allen-Bradley brand.
 - 3. Schneider Electric - Power Management Operation.

2.2 FUNCTIONAL DESCRIPTION

- A. Instrumentation and Recording Devices:
 - 1. Monitor and record load profiles and chart energy consumption patterns.
 - 2. Calculate and Record:
 - a. kW, kVAR, kVA, kWh, kVARh, kVAh.
 - b. Demand kW and peak demand, with ~~user-selectable~~ 15-minute demand interval.
 - c. Power factor and voltage / current unbalance.
- B. Power Quality Monitoring:
 - 1. Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:
 - a. Over / undervoltage.
 - b. Voltage unbalance.
 - c. Overcurrent.
 - d. Frequency deviation.
 - e. Total harmonic distortion (THD) for voltage and current, when supported by device.
- C. System Functions:

1. Display real-time metered values from all communicating meters and breaker trip units.
2. Log alarms and events with time stamps.
3. Provide historical trending of selected parameters (e.g. kW, kWh, voltage, current) for a minimum of ~~12~~ 36 months, based on storage sizing.
4. Generate user-configurable reports and export data to CSV or similar formats for analysis.
5. Provide one-line and equipment graphics for main and emergency switchboards and major downstream panels.

2.3 SYSTEM REQUIREMENTS

- A. Monitoring System:
 1. Provide one EPMS head-end server located in the telecommunications room, with application software installed.
 2. Provide web-based client access so that authorized users can view EPMS data from standard Owner PCs on the building LAN using a standard web browser.
 3. Provide communication interfaces to all metering devices, breaker trip units, and gateways as indicated on the drawings.
- B. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
 1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.
- C. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

2.4 OPERATING SYSTEM

- A. Software: Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Software shall include interactive graphics client and shall be Web enabled. Workstations and portable computers shall not require any software except for an Internet browser to provide connectivity and full functionality. Include a firewall recommended by manufacturer. 100 Base-T Ethernet, Modbus TCP/IP RS-232, and RS-485 digital communications.
- B. Operating System Software: Based on 64-bit, Microsoft Windows workstation operating system. Software shall have the following features:

1. Multiuser and multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
2. Graphical user interface to show pull-down menus and a menu tree format.
3. Capability for future additions within the indicated system size limits.

2.5 APPLICATIONS SOFTWARE

A. Basic Requirements:

1. Fully compatible with and based on the approved operating system.
2. Password-protected operator login and access; three levels, minimum.
3. Password-protected setup functions.
4. Context-sensitive online help.
5. Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
6. Capability for importing custom icons into graphic views to represent alarms and I/O devices.
7. Automatic and encrypted backups for database and history; automatically stored at selected workstation and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
8. Operator audit trail for recording and reporting all changes made to user-defined system options.

B. Workstation Server Functions:

1. Support other client PCs on the LAN.
2. Maintain recorded data in databases accessible from other PCs on the LAN.

C. Data Formats:

1. User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
2. Option to convert reports and graphics to HTML format.
3. Interactive graphics.
4. Option to send preprogrammed or operator designed e-mail reports.

D. Metered Data: Display metered values in real time.

E. Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display on monitors.

F. Graphics: Interactive color-graphics platform with pull-down menus and mouse-driven generation of power system graphics, in formats widely used for such drafting; to include the following:

1. Site plan.

2. Floor plans.
 3. Equipment elevations.
 4. Single-line diagrams.
- G. User-Defined Monitoring and Control Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:
1. Operator log on/off.
 2. Attempted operator log on/off.
 3. All alarms.
 4. Equipment operation counters.
 5. Out-of-limit, pickup, trip, and no-response events.
- H. Trending Reports: Display data acquired in real-time from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.
1. Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
 2. Charting, statistical, and display functions of standard Windows-based spreadsheet.
- I. Alarms: Display and record alarm messages from discrete input and controls outputs, according to user programmable protocol.
1. Functions requiring user acknowledgment shall run in background during computer use for other applications and override other presentations when they occur.
- J. Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event. Include the graphic displays of the following, based on user-specified criteria:
1. Phase voltages, phase currents, and residual current.
 2. Overlay of three-phase currents, and overlay each phase voltage and current.
 3. Waveforms ranging in length from 2 cycles to 5 minutes.
 4. Disturbance and steady-state waveforms up to 512 points per cycle.
 5. Transient waveforms up to 83,333 points per cycle on 60-Hz base.
 6. Calculated waveform, based on recorded data, on a minimum of four cycles of data of the following:
 - a. THD.
 - b. rms magnitudes.
 - c. Peak values.
 - d. Crest factors.
 - e. Magnitude of individual harmonics.
- K. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.

1. Tabular data shall be in the comma-separated values.
- L. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
 1. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
 2. Sort and report by device name and by function.
 3. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
 4. Differentiate alarm signals from other indications.
 5. When system is reset, report reset event with same information concerning device, location, date, and time.
- M. Display Monitor:
 1. Backlighted LCD to display metered data with touch-screen selecting device.
 2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
 3. Display four values on one screen at same time.

2.6 COMMUNICATION COMPONENTS AND NETWORKS

- A. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.7 POWER MONITORS

- A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.
 1. Enclosure: NEMA 250, Type 1.
- B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 1. Indoor installation in nontemperature-controlled spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
- C. Advanced Power Quality Meter – Building Entrance Typical
 1. The metering device used to monitor the low voltage switchboard at the building main or on the low voltage side of building main transformers shall have at minimum the following features:

- a. Voltage and current inputs—three (3) phase inputs; direct connect to 600 VAC; five (5) amperes (A) nominal current inputs.
- b. High accuracy standards—meets stringent IEC and ANSI measurement accuracy standards such as IEC 62053-22 Class 0.1S, ANSI C12.20 0.2 Class 0.1.
- c. Fault recording and waveform capture:
 - 1) Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession.
 - 2) 1024 samples per cycle waveform recording, 17 μ s transient capture (60 Hz).
 - 3) Configurable to provide COMTRADE waveforms for all captures.
- d. Disturbance detection and disturbance direction indication:
 - 1) High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance
 - 2) Detect disturbances less than one cycle in duration.
 - 3) Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.
- e. Supported measured and calculated metering parameters—four-quadrant metering,
 - 1) Energy totals
 - a) Real, reactive and apparent energy
 - b) Real energy – into the load and out of the load
 - 2) Instantaneous RMS values – (Total and per Phase)
 - a) Real, reactive and apparent power
 - b) Current (average and per phase)
 - c) Current (Neutral)
 - d) Voltage (L-L and L-N) (average and per phase)
 - e) Power factor (displacement and total)
 - f) Frequency
 - 3) Demand / Record on-board values
 - a) Real, reactive and apparent power (maximum)
 - b) Current (maximum)
 - c) Voltage (minimum and maximum)
 - d) Power Factor (minimum and maximum)
 - e) Frequency (minimum and maximum)
 - 4) Power Quality
 - a) Harmonic Distortion (voltage and current)
 - b) Individual Harmonics to 63rd harmonics
 - c) Waveform capture
 - d) Sag and Swell detection with disturbance direction detection
- f. High-visibility display with the following characteristics:
 - 1) User programmable to display up to four (4) quantities per screen.
 - 2) Capable of displaying graphical metering data such as phasor diagrams.
- g. I/O – As required and noted on the drawings for a digital status input monitoring of other devices such as HVL switch status, Blown Fuse Indication, SPD Alarm status

- h. Communications capability—multi-port Ethernet and serial communications with at least two Ethernet ports and two RS485 serial port. Functionality through Ethernet connectivity includes e-mail on alarm, on-board web server, SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus RTU protocol.
- i. On-board logging:
 - 1) Non-volatile time stamps with on-board logging of I/O conditions, alarms, and all measured parameters; waveform captures along with energy and demand.
 - 2) Continuous recording of intervals down to one-half (½) cycle.
- j. On-board web server can be used for:
 - 1) Access to real-time values and basic power quality information using web browser.
 - 2) Basic meter configuration.
- k. Alarming capabilities:
 - 1) Set-point driven alarming capability.
 - 2) Generate an email notification upon an alarm condition.
 - 3) Millisecond resolution timestamp on alarm entries.
- l. Time-stamped event log (1 millisecond resolution) with the following characteristics:
 - 1) Support at least 500 events, programmable up to a maximum of 20000 events.
 - 2) For each event, record date and time, cause and effect, and priority.
 - 3) Record all events relating to set-point activity, relay operation and self-diagnostics.
 - 4) Minimum event recording response time is one-half (½) cycle (8.3ms 60Hz) for high-speed events and one (1) second for other events.
 - 5) Programmable set-point events.
- m. Power quality analysis and compliance monitoring:
 - 1) Without separate software, have the following capabilities:
 - a) Display statistical indicators of power quality on the front display.
 - b) Compare power quality parameters with an absolute or relative set point, and alert (via e-mail or pager).
 - c) Support EN50160 reporting for compliance monitoring.
 - 2) Low pass anti-aliasing signal.
- n. Schneider Electric ION9000 series, Eaton PXM3000 or approved equal by the switchboard manufacturer.

D. Breaker Metering Trip Unit

- 1. The metering device used on main and feeder breakers in switchboards, distribution panelboards and main breakers on panelboards; provide basic metering of the load and also breaker condition information and activity (loads from 6,000A to 15 A as designated on the drawings):
 - a. Voltage reference – provided by the switchboard or distribution panel source in trip unit.

- b. Current sensing – provided through the breaker protection current transformers.
- c. Supported monitoring parameters—full range of 3-phase voltage, current, power, and energy measurements.
 - 1) Energy totals
 - a) Real, reactive and apparent energy
 - b) Real energy – into the load and out of the load
 - 2) Instantaneous RMS values – (Total and per Phase)
 - a) Real, reactive and apparent power
 - b) Current (average and per phase)
 - c) Current (Neutral and Ground)
 - d) Current % of Load
 - e) Current unbalanced
 - f) Voltage (L-L and L-N) (average and per phase)
 - g) Voltage unbalance
 - h) Power factor (displacement)
 - i) Frequency
 - 3) Demand readings with Date and Time
 - a) Real, reactive and apparent power (maximum)
 - b) Current (maximum)
 - 4) Minimum and Maximum readings
 - a) Voltage (minimum and maximum)
 - b) Crest Factor
 - c) Power Factor (minimum and maximum)
 - d) Frequency (minimum and maximum)
 - 5) Breaker Information
 - a) Status – Open / Closed / Tripped
 - b) Last Trip – Date and Time
 - c) Ground Fault Alarm Status
 - d) Trip settings of breaker
- d. Communications – metering trip units are internally wired serial RS-485 Modbus, Ethernet Modbus TCP through a gateway provide two Ethernet ports. Through a standard web browser; and monitor breaker load, status and settings in default pages from the factory.
- e. Schneider Electric Micrologic Type P trip unit and Type E trip unit, Eaton PXR 25 or approved equal, by the switchboard manufacturer.

E. Metering Enclosures

- 1. Any metering enclosed cabinets supplied shall meet the following specifications:
 - a. Minimum UL type 1 listed steel enclosure with factory-supplied knockouts.
 - b. Lockable and provide for the application of a security seal.
 - c. Available options for NEMA Type 1 and Type 4X applications.
 - d. Single set of incoming terminals for connecting the voltage metering leads.
 - e. Control power and voltage sensing power separated for distribution to each meter from main set of incoming terminals.
 - f. External control power transformers not required for any power systems up to, and including, 480 volts.

- g. Standard wiring harnesses for control power and voltage sensing to connect each meter internally.
- h. Common daisy chain wiring for communications wiring, with a single loop for all meters connected to the circuit and each end terminated in a common location. Communication wiring installed such that interference from the power wiring is minimized.
- i. Shorting terminal blocks for connecting the current transformer leads from the field to all ordered meters.
- j. Terminal blocks for incoming and outgoing communications circuit connections.

F. Onboard Data Logging:

- 1. Store logged data, alarms, events, and waveforms in 800 KB of onboard nonvolatile memory.
- 2. Stored Data:
 - a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 and 52 days of 15-minute interval data, depending on number of quantities selected.
 - b. Custom Data Logs: Three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
 - 1) Schedule interval.
 - 2) Event definition.
 - 3) Configured as "fill-and-hold" or "circular, first-in first-out."
 - c. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
 - d. Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."
- 3. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

G. Alarms.

- 1. User Options:
 - a. Define pickup, dropout, and delay.
 - b. Assign one of four severity levels to make it easier for user to respond to the most important events first.
 - c. Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.
- 2. Alarm Events:

- a. Over/undercurrent.
- b. Over/undervoltage.
- c. Current imbalance.
- d. Phase loss, current.
- e. Phase loss, voltage.
- f. Voltage imbalance.
- g. Over kW demand.
- h. Phase reversal.
- i. Digital input off/on.
- j. End of incremental energy interval.
- k. End of demand interval.

- H. Control Power: 90- to 457-V ac or 100- to 300-V dc.

2.8 WORKSTATION HARDWARE

- A. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
- 1. Indoor installation in spaces that have environmental controls to maintain ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
- B. Server: 19-inch rack-mount server (1U or 2U) or virtual machine as approved by Owner IT, designed for the latest version of Windows operating system.
- 1. Server style will be stand alone with power monitoring application and database residing on the same machine.
 - 2. 64 GB RAM or more
 - 3. Hard Disk - 2 – 1 TB HD in RAID 1 configuration for back-up
 - 4. Microsoft Operating System shall be the latest.
 - 5. Microsoft SQL Server shall be the latest appropriate licensed for server size.
 - 6. Microsoft Excel and PDF viewer for local report export viewing
 - 7. Any device licenses shall be 25% more than immediately required for future expansion.
 - 8. Monitor – 21-inch LED or larger for easy viewing
 - 9. Web clients – 5 or more for remote user viewing
 - 10. Printer – color laser for print out of reports and disturbance waveforms.
 - 11. Power to be supplied from UPS circuit for system stability

2.9 LAN CABLES

- A. Comply with Section 271500 "Communications Horizontal Cabling."
- B. RS-485 Cable:

1. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
 2. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket, and NFPA 70, Type CMP.
- C. Unshielded Twisted Pair Cables: Category 6 as specified for horizontal cable for data service in Section 27 15 00 "Communications Horizontal Cabling."

2.10 LOW-VOLTAGE WIRING

- A. Comply with Section 260523 "Control-Voltage Electrical Power Cables."
- B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
 1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
 2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
 3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND COMMISSIONING

- A. Installation.
 1. System components, including meters, electronic trip units, sensors, motor protection devices, relays, etc. included within power equipment lineups, shall be factory installed, wired, and tested prior to shipment to the job site.
 2. All control power, CT, PT, and data communications wiring shall be factory wired and harnessed within the equipment enclosure.
 3. All external wiring required to connect equipment lineups shall be installed by the electrical contractor.
 4. Contractor interconnection wiring requirements shall be identified on system drawings.

5. Vendor field technicians shall verify accuracy of installation prior to commissioning.
- B. System Commissioning and Acceptance.
 1. Factory-trained personnel shall perform on-site commissioning using automated commissioning tools to improve consistency and quality of commissioning.
 2. Engineering drawings shall be made available to the client for all EPMS projects.
 3. On-site commissioning and initial user training of the EPMS shall be included in bid.
 4. Commissioning shall include detailed scope of work checklist document with delivered functionality listed and checked. Shall include a screen capture and backup of all graphic.
 5. Commissioning shall include a full working demonstration of the system under normal operating conditions and simulated scenarios.

3.3 CABLING

- A. Comply with NECA 1.
- B. Install cables and wiring according to requirements in Section 271500 "Communications Horizontal Cabling."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces. Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.
- E. Install cables without damaging conductors, shield, or jacket.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
- B. Label each power monitoring and control module with a unique designation.

3.5 GROUNDING

- A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Electrical Tests: Use caution when testing devices containing solid-state components.
 - 2. Continuity tests of circuits.
 - 3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.
 - a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled. Test LANs according to requirements in Section 271500 "Communications Horizontal Cabling."
 - b. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
 - c. Verify accuracy of graphic screens and icons.
 - d. Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
 - e. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

- E. Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- J. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. See Section 017900 "Demonstration and Training."
 - 1. Train Owner's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 6 hours' training.
 - 2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

3.8 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 12 19

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

(Part of Work of Section 26 00 01 – ELECTRICAL, Trade Bid Required)

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.
- A-B. The pad-mounted, liquid-filled, medium-voltage transformer has been pre-purchased by the Construction Manager. Refer to 26 00 01.1 for additional information and requirements regarding this equipment.

1.2 SUMMARY

- A. Section includes pad-mounted, liquid-filled, medium-voltage distribution transformers, with primary and secondary bushings within or without air-terminal enclosures.

1.3 DEFINITIONS

- A. BIL: Basic Impulse Insulation Level.
- B. Bushing: An insulating structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.
- C. Bushing Elbow: An insulated device used to connect insulated conductors to separable insulated connectors on dead-front, pad-mounted transformers and to provide a fully insulated connection. This is also called an "elbow connector."

- D. Bushing Insert: That component of a separable insulated connector that is inserted into a bushing well to complete a dead-front, load break or nonload break, separable insulated connector (bushing).
- E. Bushing Well: A component of a separable insulated connector, either permanently welded or clamped to an enclosure wall or barrier, having a cavity that receives a replaceable component (bushing insert) to complete the separable insulated connector (bushing).
- F. Elbow Connector: See "bushing elbow" above.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For pad-mounted, liquid-filled, medium-voltage transformers.
 - 1. Include plans and elevations showing major components and features.
 - a. Include a plan view and cross section of equipment base, showing clearances, required workspace, and locations of penetrations for grounding and conduits.
 - 2. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include single-line diagram.
 - 4. Include list of materials.
 - 5. Include nameplate data.
 - 6. Manufacturer's published time-current curves of the transformer high-voltage fuses, with transformer damage curve, inrush curve, and thru fault current indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For transformer assembly, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For transformers, signed by product manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2.
- C. Comply with IEEE C57.12.00.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: The transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified and the transformer will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.
 - 3. Component Amplification Factor: 2.5.
 - 4. Component Response Modification Factor: 3.0.
- B. Windings Material: Aluminum.
- C. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, fully shielded, separable-elbow type, suitable for plugging into the inserts provided in the high-voltage section of the transformer. Connected in each phase of incoming circuit and ahead of any disconnecting device.
- D. Winding Connections: The connection of windings and terminal markings shall comply with IEEE C57.12.70.
- E. Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Insulation: Transformer kVA rating shall be as follows: The average winding temperature rise above a 30 deg C ambient temperature shall not exceed 65 deg C

and 80 deg C hottest-spot temperature rise at rated kVA when tested according to IEEE C57.12.90, using combination of connections and taps that give the highest average winding temperature rise.

- G. Tap Changer: External handle, for de-energized operation.
- H. Tank: Sealed, with welded-on cover. Designed to withstand internal pressure of not less than 7 psi (50 kPa) without permanent distortion and 15 psig (104 kPa) without rupture. Comply with IEEE C57.12.36.
- I. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to the public.
- J. Mounting: An integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.
- K. Insulating Liquids:
 - 1. Less-Flammable Liquids:
 - a. Edible-Seed-Oil-Based Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92. Liquid shall be biodegradable and nontoxic, having passed the Organisation for Economic Co-operation and Development G.L.203 with zero mortality, and shall be certified by the U.S. Environmental Protection Agency as biodegradable, meeting Environmental Technology Verification requirements.
 - b. Biodegradable and Nontoxic Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92.
- L. Sound level shall comply with NEMA TR 1 requirements.
- M. Corrosion Protection:
 - 1. Transformer coating system shall be factory applied, complying with requirements of IEEE C57.12.28, in manufacturer's standard color green.
 - 2. Fabricate front sill, hood, and tank base of single-compartment transformers from stainless steel according to ASTM A167, Type 304 or 304L, not less than

No. 13 U.S. gage, complying with requirements of IEEE C57.12.28, standard color green.

3. Base and Cabinets of Two Compartment Transformers: Fabricate from stainless steel according to ASTM A167, Type 304 or 304L, not less than No. 13 U.S. gage. Coat transformer with manufacturer's standard green color coating complying with requirements of IEEE C57.12.28, in manufacturer's standard color green.

2.3 THREE-PHASE TRANSFORMERS

A. Manufacturers:

1. Eaton (Cooper Power)
2. Hitachi Energy
3. Schneider Electric
4. ABB, Inc.

B. Description:

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with IEEE C57.12.26.

C. Compartment Construction:

1. Single-Compartment Construction: Clamshell style, with provision for padlocking, hinged cover, and single-point latching.
2. Double-Compartment Construction: Individual compartments for high- and low-voltage sections, formed by steel isolating barriers that extend full height and depth of compartments, with hinged, lift-off doors and three-point latching, with a stop in the open position and provision for padlocking.

D. Primary Fusing: Designed and rated to provide thermal protection of transformer by sensing overcurrent and high liquid temperature.

1. 150-kV BIL current-limiting fuses, conforming to requirements of IEEE C37.47.
2. Interrupting Rating: 50,000 rms A symmetrical at system voltage.
3. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse shall sense both high currents and high oil temperature to provide thermal protection to the transformer. Connect current-limiting fuses ahead of radial-feed load-break switch.
4. Provide bayonet fuse assembly with an oil retention valve and an external drip shield inside the housing to eliminate or minimize oil spills. Valve shall close when fuse holder is removed and an external drip shield is installed.
5. Provide a conspicuously displayed warning adjacent to bayonet fuse(s), cautioning against removing or inserting fuses unless transformer has been de-energized and tank pressure has been released.

E. High-Voltage Section: Dead-front design.

1. To connect primary cable, use separable insulated connectors; coordinated with and complying with requirements of Section 26 05 13 "Medium-Voltage Cables." Bushings shall be one-piece units, with ampere and BIL ratings the same as connectors.
2. Bushing inserts and feed-through inserts:
 - a. Conform to the requirements of IEEE 386.
 - b. Rated at 200 A, with voltage class matching connectors. Provide a parking stand near each bushing well. Parking stands shall be equipped with insulated standoff bushings for parking of energized load-break elbow connectors on parking stands.
 - c. Provide insulated protective caps for insulating and sealing out moisture from unused bushing inserts and insulated standoff bushings.
3. Bushing wells configured for loop-feed application.

4. Access to liquid-immersed fuses.
5. Dead-front surge arresters.
6. Tap-changer operator.
7. Load-Break Switch:
 - a. Radial-feed, liquid-immersed type with voltage class and BIL matching that of separable connectors, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 12 kA rms symmetrical.
 - b. Loop-feed sectionalizing switches, using three two-position, liquid-immersed-type switches for closed transition loop-feed and sectionalizing operation. Voltage class and BIL shall match that of separable connectors, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 12 kA rms symmetrical. Switch operation shall be as follows:
 - 1) Position I: Line A connected to line B and both lines connected to the transformer.
 - 2) Position II: Transformer connected to line A only.
 - 3) Position III: Transformer connected to line B only.
 - 4) Position IV: Transformer disconnected and line A not connected to line B.
 - 5) Position V: Transformer disconnected and line A connected to line B.
8. Ground pad.

F. Low-Voltage Section:

1. Bushings with spade terminals drilled for terminating the number of conductors indicated on the Drawings, and the lugs that comply with requirements of Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

G. Capacities and Characteristics:

1. Power Rating (kVA): As indicated on drawings.
2. Voltage Ratings: As indicated on drawings.
3. Taps: Comply with IEEE C57.12.26 requirements; provide $\pm 2 \times 2.5$ percent (four total taps), de-energized no-load tap changer (DNLT), unless otherwise indicated.
4. Transformer BIL (kV): Comply with IEEE C57.12.26 requirements; minimum BIL = 95 kV for 15 kV class.
5. Minimum Tested Impedance (Percent at 85 deg C): Provide impedance consistent with IEEE C57.12.26 for the specified kVA rating; minimum impedance =4.03 for 1000-2500 kVA.
6. K-factor: K-1, complying with UL 1562.
7. Comply with FM Global Class No. 3990.
8. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.

H. Transformer Accessories:

1. Drain and filter connection.
2. Filling and top filter press connections.
3. Pressure-vacuum gauge.
4. Dial-type analog thermometer with alarm contacts.
5. Magnetic liquid level indicator with high and low alarm contacts.
6. Automatically resetting pressure-relief device. Device flow shall be as recommended by manufacturer. With alarm contacts and a manual bleeder.
7. Stainless-steel ground connection pads.
8. Machine-engraved nameplate, made of anodized aluminum or stainless steel.
9. Sudden pressure relay for remote alarm or trip when internal transformer pressure rises at field-set rate. Provide with seal-in delay.

2.4 SERVICE CONDITIONS

- A. Transformers shall be suitable for operation under service conditions specified as usual service conditions in IEEE C57.12.00, except for the following:
1. Altitudes above 3300 feet (1000 m).
 2. Cooling air temperature exceeds limits.
 3. Excessive load current harmonic factor.
 4. Operation above rated voltage or below rated frequency.
 5. Exposure to explosive environments.
 6. Exposure to fumes, vapors, or dust.
 7. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
 8. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
 9. Exposure to excessively high or low temperatures.
 10. Unusual transportation or storage conditions.
 11. Unusual grounding resistance conditions.

2.5 CONTROL NETWORK

- A. Controllers: Support serial MS/TP and Ethernet IP communications, and able to communicate directly via RS-485 serial networks and Ethernet 10Base-T networks as a native device.

2.6 WARNING LABELS AND SIGNS

- A. Comply with requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."
1. High-Voltage Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s). Sign legend shall be "DANGER HIGH PAD MOUNTED, LIQUID-FILLED, MEDIUM VOLTAGE TRANSFORMERS

"VOLTAGE" printed in two lines of nominal 2-inch- (50-mm)-high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.

2. Arc Flash Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s), warning of potential electrical arc flash hazards and appropriate personal protective equipment required.

2.7 SOURCE QUALITY CONTROL

- A. Provide manufacturer's certificate that the transformer design tests comply with IEEE C57.12.90.

1. Perform the following factory-certified routine tests on each transformer for this Project:

- a. Resistance.
 - b. Turns ratio, polarity, and phase relation.
 - c. Transformer no-load losses and excitation current at 100 percent of ratings.
 - d. Transformer impedance voltage and load loss.
 - e. Operation of all devices.
 - f. Lightning impulse.
 - g. Low frequency.
 - h. Leak.
 - i. Transformer no-load losses and excitation current at 110 percent of ratings.
 - j. Insulation power factor.
 - k. Applied potential, except that this test is not required for single-phase transformers or for three-phase Y-Y-connected transformers.
 - l. Induced potential.
 - m. Resistance measurements of all windings on rated voltage connection and at tap extreme connections.
 - n. Ratios on rated voltage connection and at tap extreme connections.

- o. Polarity and phase relation on rated voltage connection.
- p. No-load loss at rated voltage on rated voltage connection.
- q. Exciting current at rated voltage on rated voltage connection.
- r. Impedance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pad-mounted, liquid-filled, medium-voltage transformers upon delivery.
 - 1. Upon delivery of transformers and prior to unloading, inspect equipment for any damage that may have occurred during shipment or storage.
 - 2. Verify that tie rods and chains are undamaged and tight, and that all blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
 - 3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.
 - 4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on high- or low-voltage bushing parts, and at transformer base.
 - 5. Verify that there is positive pressure or vacuum on tank. Check pressure gauge; it is required to read other than zero.
 - 6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
 - 7. Verify presence of polychlorinated biphenyl content labeling.

8. Unload transformers carefully, observing all packing label warnings and handling instructions.
9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
2. Protect transformer termination compartments against entrance of dust, rain, and snow.
3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in windings. Do not tilt or tip transformers.
4. Verify that transformer weights are within rated capacity of handling equipment.
5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use all lifting lugs when lifting transformers.
6. Use jacks only at corners of tank base plate.
7. Use nylon straps of same length to balance and distribute weight when handling transformers with a crane.
8. Use spreaders or a lifting beam to obtain a vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:

1. Store transformers in accordance with manufacturer's recommendations.
 2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
 3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.
 4. Store transformers with compartment doors closed.
 5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions. Verify that an effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.
- D. Examine areas and space conditions for compliance with requirements for pad-mounted, liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.
- E. Examine roughing-in of conduits and grounding systems to verify the following:
1. Wiring entries comply with layout requirements.
 2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.
- F. Examine concrete bases for suitable conditions for transformer installation.
- G. Pre-Installation Checks:
1. Verify removal of any shipping bracing after placement.
 2. Remove a sample of insulating liquid according to ASTM D923. Insulating-liquid values shall comply with NETA ATS, Table 100.4. Sample shall be tested for the following:
 - a. Dielectric Breakdown Voltage: ASTM D877 or ASTM D1816.

- b. Acid Neutralization Number: ASTM D974.
 - c. Specific Gravity: ASTM D1298.
 - d. Interfacial Tension: ASTM D971.
 - e. Color: ASTM D1500.
 - f. Visual Condition: ASTM D1524.
 - g. Water in Insulating Liquids: Comply with ASTM D1533.
 - h. Power Factor or Dissipation Factor: ASTM D924.
- H. Verify that ground connections are in place and that requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at transformer location.
- I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Transformer shall be installed level and plumb and shall tilt less than 1.5 degrees while energized.
- C. Comply with requirements for vibration isolation and seismic control devices specified in Section 26 05 29 "Hangers and Supports for Electrical Systems" and Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and IEEE C2.

3.3 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
 - 1. For counterpoise, use tinned bare copper cable not smaller than No. 4/0 AWG, buried not less than 30 inches (765 mm) below grade interconnecting the grounding electrodes. Bond surge arrester and neutrals directly to

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transformer enclosure and then to grounding electrode system with bare copper conductors, sized as shown. Keep lead lengths as short as practicable, with no kinks or sharp bends.

2. Fence and equipment connections shall not be smaller than No. 4 AWG. Ground fence at each gate post and corner post and at intervals not exceeding 10 ft. (3050 mm). Bond each gate section to fence post using 1/8 by 1 inch (3 by 25 mm) tinned flexible braided copper strap and clamps.
 3. Make joints in grounding conductors and loops by exothermic weld or compression connector.
 4. Terminate all grounding and bonding conductors on a common equipment grounding terminal on transformer enclosure.
 5. Complete transformer tank grounding and lightning arrester connections prior to making any other electrical connections.
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.
 2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.
- C. Terminate medium-voltage cables in incoming section of transformers according to Section 26 05 13 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

- A. Comply with installation requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. General Field-Testing Requirements:

- a. Comply with provisions of NFPA 70B Ch. "Testing and Test Methods."
- b. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
- c. After installing transformer but before primary is energized, verify that grounding system at the transformer is tested at specified value or less.
- d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
- e. Visual and Mechanical Inspection:
 - 1) Verify equipment nameplate data complies with Contract Documents.
 - 2) Inspect bolted electrical connections for high resistance using one of the following two methods:
 - a) Use a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.
- f. Remove and replace malfunctioning units and retest.
- g. Prepare test and inspection reports. Record as-left set points of all adjustable devices.

2. Medium-Voltage Surge Arrester Field Tests:

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a. Visual and Mechanical Inspection:

- 1) Inspect physical and mechanical condition.
- 2) Verify arresters are clean.
- 3) Verify that ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical Test:

- 1) Perform an insulation-resistance test on each arrester, phase terminal-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to comply with recommended minimum insulation resistance listed in that table.
- 2) Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.

3. Liquid-Filled Transformer Field Tests:

a. Visual and Mechanical Inspection:

- 1) Test dew point of tank gases if applicable.
- 2) Inspect anchorage, alignment, and grounding.
- 3) Verify bushings are clean.
- 4) Verify that alarm, control, and trip settings on temperature and level indicators are set and operate within manufacturer's recommended settings.
- 5) Verify that liquid level in tanks is within manufacturer's published tolerances.
- 6) Perform specific inspections and mechanical tests recommended by manufacturer.
- 7) Verify presence of transformer surge arresters and that their ratings are as specified.

- 8) Verify that as-left tap connections are as specified.

b. Electrical Tests:

- 1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; the value of the index shall not be less than 1.0.
- 2) Perform power-factor or dissipation-factor tests on all windings according to test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.3.
- 3) Measure core insulation resistance at 500-V dc if the core is insulated and the core ground strap is removable. Core insulation-resistance values shall not be less than 1 megohm at 500-V dc.
- 4) Perform a power-factor or dissipation-factor tip-up test on windings greater than 2.5 kV.
- 5) Perform turns-ratio tests at tap positions. Turns-ratio test results shall not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
- 6) Perform an excitation-current test on each phase. The typical excitation-current test data pattern for a three-legged core transformer is two similar current readings and one lower current reading. Investigate and correct if test shows a different pattern.
- 7) Measure resistance of each winding at each tap connection, and record temperature-corrected winding-resistance values in the Operations and Maintenance Manual.
- 8) Perform an applied-voltage test on high- and low-voltage windings-to-ground. Comply with IEEE C57.12.91, Sections 10.2 and 10.9. This test is not required for single-phase transformers and for three-phase Y-Y-connected transformers.
- 9) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

- 10) Remove a sample of insulating liquid according to ASTM D923, and perform dissolved-gas analysis according to IEEE C57.104 or ASTM D3612.

3.6 FOLLOW-UP SERVICE

- A. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:
 1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each transformer. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards and with a chart speed of not less than 1 inch (25 mm) per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during test period, is unacceptable.
 2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
 - a. Adjust transformer taps.
 - b. Prepare written request for voltage adjustment by electric utility.
 3. Retests: Repeat monitoring, after corrective action is performed, until satisfactory results are obtained.
 4. Report:
 - a. Prepare a written report covering monitoring performed and corrective action taken.
- B. Infrared Inspection: Perform survey during periods of maximum possible loading. Remove all necessary covers prior to inspection.
 1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of transformer's electrical power connections.

2. Instrument: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
3. Record of Infrared Inspection: Prepare a certified report that identifies testing technician and equipment used, and lists results as follows:
 - a. Description of equipment to be tested.
 - b. Discrepancies.
 - c. Temperature difference between area of concern and reference area.
 - d. Probable cause of temperature difference.
 - e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
 - f. Identify load conditions at time of inspection.
 - g. Provide photographs and thermograms of deficient area.
4. Act on inspection results according to recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION

SECTION 26 13 23**MEDIUM-VOLTAGE, METAL-ENCLOSED SWITCHGEAR****(Part of Work of Section 26 00 01 – ELECTRICAL, Trade Bid Required)****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.
- A-B. The medium-voltage, metal-enclosed switchgear has been pre-purchased by the Construction Manager. Refer to 26 00 01.1 for additional information and requirements regarding this equipment.

1.2 SUMMARY

- A. Section includes outdoor metal-enclosed interrupter switchgear.

1.3 DEFINITIONS

- A. BIL: Basic Impulse Insulation Level.
- B. SCADA: Supervisory control and data acquisition.
- C. VRLA: Valve-regulated, recombinant, lead-calcium acid.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 2. Time-current characteristic curves for overcurrent protective devices.
- B. Shop Drawings: For medium-voltage, metal-enclosed switchgear.
1. Include a tabulation of installed devices with features and ratings.
 2. Include dimensioned plans and elevations, showing dimensions, shipping sections, and weights of each assembled section. Elevations shall show major components, features, and mimic bus diagram.

3. Include a plan view and cross section of equipment base showing clearances, manufacturer's recommended work space, and locations of penetrations for grounding and conduits. Show location of anchor bolts and leveling channels.
4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, and location and size of each field connection.
5. Locate accessory and spare equipment storage.
6. Include single-line diagram.
7. Include control power wiring diagrams.
8. Include copy of nameplate.
9. Ratings of the assembled switchgear:
 - a. Voltage.
 - b. Continuous current.
 - c. Short-circuit rating.
 - d. BIL.
10. Utility company's metering provisions with indication of approval by utility company.
11. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting seismic restrains.
12. ints.
13. Wiring Diagrams: For each switchgear assembly include the following:
 - a. Power, signal, and control wiring.
 - b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
 - c. Schematic control diagrams.
 - d. Diagrams showing connections of component devices and equipment.
 - e. Schematic diagrams showing connections to remote devices.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Outdoor Installations:
 - a. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement.
 - b. Dimensioned concrete base, outline of the switchgear, conduit entries, and grounding equipment locations.
2. Indoor Installations:
 - a. Dimensioned concrete base, outline of the switchgear, conduit entries, and grounding equipment locations.
 - b. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways, cable trays, and seismic anchors.

- c. Location of lighting fixtures, sprinkler piping and heads, ducts, and diffusers.
- B. Qualification Data: For professional engineer and testing agency.
- C. Seismic Qualification Data: Certificates, for switchgear and control power, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For switchgear, signed by product manufacturer.
- E. Source quality-control reports.
- F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Six of each type and rating of fuse and fusible device used, except for medium-voltage fuses. Include spares for the following:
 - a. Primary disconnect fuses.
 - b. Potential transformer fuses.
 - c. Control power fuses.
 - d. Fuses and fusible devices for fused circuit breakers.
 - 2. Spare Indicating Lights: Six of each type installed.

3. Primary Switch Contact Lubricant: One container(s).

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 1. Testing Agency's Field Supervisor: Certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in "Field Quality Control" Article.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Manufactured Unit: Metal-enclosed switchgear..
- B. Switchgear Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with IEEE C37.20.3.

2.2 MANUFACTURERS

- A. S&C Electric Company
- B. Eaton Corporation
- C. ABB Inc.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: The switchgear shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means the switchgear will remain in place without separation of any parts when subjected to the seismic forces specified and the switchgear will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.
 3. Component Amplification Factor: 2.5.
 4. Component Response Modification Factor: 3.0.
- B. Service Conditions:

1. Switchgear shall be suitable for operation under service conditions specified as usual service conditions in IEEE C37.20.3.

2.4 CONSTRUCTION

- A. To ensure a completely coordinated design, the metal-enclosed switchgear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances and adequate space for fuse handling.
- B. Enclosure Construction
 1. In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access; tamper resistance; corrosion resistance; protection from ingress of rodents, insects, and weeds; and the possibility of arcing faults within the enclosure.
 2. The enclosure of each bay shall be unitized monocoque construction to maximize strength, minimize weight, and inhibit corrosion.
 3. The material for all external sides of the enclosure and the roof shall be 11-gauge hot-rolled, pickled and oiled steel sheet.
 4. Each bay containing high-voltage components shall be a complete unit in itself, with full side sheets resulting in double-wall construction between bays. To guard against unauthorized or inadvertent entry, side and rear sheets and the top shall not be externally bolted.
 5. The base shall be a continuous steel channel of a thicker gauge material than used for the enclosure and shall extend completely around all four sides of each bay.
 6. Access to the interior of the enclosure shall be from the front only, allowing placement of the metal-enclosed switchgear assembly tight against a wall or back-to-back to minimize floor-space requirements.
 7. To guard against unauthorized or inadvertent entry, there shall be no access to high voltage through side or rear sheets of the metal-enclosed switchgear assembly; and no access to high voltage by means of externally removable panels.
 8. To guard against corrosion, all hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc-nickel-plated materials. Cadmium -plated ferrous parts shall not be used.
 9. Externally accessible hardware shall not be used for support of high-voltage components or switch-operating mechanisms within the switchgear.
- C. DOOR CONSTRUCTION
 1. Doors shall be constructed of 11-gauge hot-rolled, pickled, and oiled steel sheet.
 2. Doors shall have 90-degree flanges and shall overlap with the door openings. For strength and rigidity, and to minimize exposure, the door flanges shall be welded at the corners and shall be formed (at the top and both sides as a minimum) with a double bend so that the sheared-edge flanges at the top

and both sides fold back parallel to the inside of the door. The double bend is not required on arc-resistant switchgear.

3. Doors over 40 inches in height shall have a minimum of three concealed galvanized steel
4. or non-ferrous hinges with stainless-steel hinge pins. Doors 40 inches in height or less shall have a minimum of two such hinges.
5. Each door shall be equipped with a door handle. The door handle shall be padlockable and, on outdoor gear, shall incorporate a hood to protect the padlock shackle from tampering.
6. In consideration of controlled access, tamper resistance, and arcing faults, each door over 40 inches in height shall have a minimum of three concealed, interlocking, high-strength latches. Doors 40 inches in height or less shall have a minimum of two sure latches.
7. Doors providing access to interrupter switches or interrupter switches with power fuses shall be provided with a wide-view window, constructed of an impact-resistant material, to facilitate checking of switch position without opening the door.
8. Doors providing access to fuses or fused voltage transformers shall have provisions to store spare fuse units, refill units, or interrupting modules.
9. All doors providing access to high-voltage components shall be provided with a sturdy, self-latching door holder, which shall be zinc-nickel plated and chromate dipped.

D. ACCESS CONTROL

1. Doors providing access to interrupter switches with fuses shall be mechanically or key interlocked to guard against:
 - a. Opening the door if the interrupter switch on the source side of the fuse is closed, and
 - b. Closing the interrupter switch if the door is open.
2. Doors providing access to interrupter switches only, which are operated by stored-energy type switch operators, shall be mechanically interlocked to guard against operating the interrupter switch if the door is open.
3. Doors and hinged-bolted panels providing access to high-voltage components shall be provided with flush-mounted key-operated snaplocks and shall have provisions for padlocking.

E. INTERNAL PROTECTIVE SCREENS

1. In addition to the enclosure door, each bay or compartment thereof containing high-voltage components shall be provided with an internal protective screen, bolted closed, to guard against inadvertent entry to bays containing these components when the enclosure door is open.
2. Each bay containing a control-power transformer capable of 5 kVA or greater output shall be provided with an internal protective screen, bolted closed, to guard against inadvertent contact with the primary fuse when the enclosure door is open. In such cases, the screen shall also be interlocked to ensure that the secondary load has been disconnected prior to removal of these fuses.

F. INSULATORS

1. The interrupter-switch and fuse-mounting insulators, main-bus support insulators, insulated operating shafts, and (if applicable) push rods shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:
 - a. Operating experience of at least 15 years under similar conditions.
 - b. Adequate leakage distance established by test per IEC publication 507, First Edition, 1975.
 - c. Adequate strength for short-circuit stress established by test.
 - d. Conformance with applicable ANSI standards.
 - e. Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of switchgear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
 - f. Isolating through-bushings for the 13.8-kV switchgear assembly shall be provided between all bays to guard against the propagation of a fault from one bay into the adjacent bay when there is more than one bay. The isolating through-bushings shall have features and capabilities as follows:
 - i. The bushings shall be of a nontracking, self-scouring, nonweathering cycloaliphatic epoxy resin. Such bushings shall be the only dielectric insulating material between the energized bus conductor and the ground plane.
 - j. Single semiconducting material is permissible as an interface between the energized conductors and bushings. Isolating systems that incorporate multiple insulating materials in series shall not be acceptable, thus avoiding generation of corona that can break down the weakest insulation.
 - k. The bushings shall be designed for adequate BIL and certified tests shall be provided upon request.
 - m. The bushings shall provide a minimum of 12-1/2 inches of leakage distance between the energized bus conductor and the ground plane.
 - n. To avoid thermally induced stresses that are likely to cause interface separation and failure, the bus conductor shall not be molded or cemented into the bushing.
 - o. To avoid multiple insulating materials in series that are likely to cause voltage stresses that may lead to failure, the bus conductors shall not be covered with any insulating material in an effort to achieve BIL or increased leakage distance at locations where the bus passes through the bays.
 - p. The openings between the bushings and bus conductors shall be closed with a semiconducting grommet and, to avoid multiple insulating materials in series, insulating materials such as fiberglass or porcelain shall not be used for such purpose.

- r. Bushing bus conductors and main bus conductors shall be designated for direct connection and shall not require laminated or flexible bus connections.
- s. The manufacturer of the switchgear assembly shall furnish, upon request, certified tests that establish the capability of the isolating through-bushing, bus conductor, and connections to meet the short-circuit rating of the switchgear assembly. Certified tests shall be furnished, upon request, that establish the capability of the bus connections to meet applicable temperature-rise requirements.
- t. To minimize space requirements, the overall length of the bushing shall be a maximum of 9-1/2 inches from end to end.
- u. To avoid mechanical stresses that are likely to cause interface separation and failure, the isolating through-bushing shall include a flange at the ground-plane interface that shall be a formed homogeneous section of the bushing and not a separate part of dissimilar material that is molded or cemented to the bushing.
- v. Bushings shall be secured to the ground plane by clamps that overlap the bushing flanges and press the flanges securely against the ground plane to seal the openings and restrict the propagation of ionized gases between bays.
- w. For outdoor or dripproof applications, a drain channel shall be installed above the isolating through-bushings as a backup for the bay-to-bay gasketing so that any moisture entering between bays will not fall on the bushing or the bus.

G. BUS

- 1. High-Voltage Main Bus
 - a. Bus and interconnections shall consist of copper bar with silver plated joints.
 - b. The bus supports, bus, and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the switchgear.
 - c. Bolted connections shall be made with 1/2"-13 bronze bolts with two Belleville spring washers per bolt, one under the bolt head and one under the nut. These bolts shall be tightened to 50 foot-pounds torque.
 - d. Bus to which cable will be terminated shall be equipped with grounding provisions. Grounding provisions shall also be provided on the ground bus in such bays.
- 2. Ground Bus
 - a. A ground bus of short-circuit rating equal to that of the integrated assembly (or a ground connection, in the case of single-bay switchgear) shall be provided, maintaining electrical continuity throughout the metal-enclosed switchgear.
 - b. The ground bus shall be copper.
 - c. In each bay, the ground bus (or connector) shall be bolted to a nickel-plated steel bracket, which shall be welded in place.
 - d. Nickel-plated steel brackets (at least one per bay) shall have a short-time current-carrying capability consistent with the short-circuit rating of the metal-enclosed switchgear.

- e. Bolted connections shall be as specified for the main bus, except that only one Belleville spring washer shall be required per bolt for attachment of ground bus to the nickel-plated steel bracket.
- f. For multi-bay metal-enclosed switchgear assemblies, two ground cable connectors accommodating No. 2 through 500 kc mil conductors shall be provided for connection of ground bus to station ground.

H. Low-Voltage Components

- 1. All low-voltage components, switch operators (except those integrally mounted in the switchgear stile), source-transfer controls, meters, instruments, and relays, shall be located in grounded, metal-enclosed compartments separate from high voltage to provide isolation and shall be arranged to allow complete accessibility for operation without exposure to high voltage.
- 2. Space heaters, where used, shall have a grounded, perforated, galvanized steel guard.
- 3. To provide isolation from high voltage, low-voltage wiring, except for short lengths such as at terminal blocks or at secondaries of sensing devices, shall be in grounded conduit, cable trays, or raceways.

I. Cable-Termination Space

- 1. To facilitate cable pulling and installation of cable terminators, provisions shall be made for:
 - a. Full front access for positioning and removal of cable pulling sheaves.
 - b. Free access without interference from nonremovable structural members or from mechanical linkages between the interrupter-switch blades and operating mechanism.
 - c. Switchgear bay shall have provisions for incoming cable through the roof of the switchgear bay and a removable plate on the side of the switchgear bay for the exiting cable.

J. Reverse Power Relaying

- 1. 3 VT's connected phase to ground shall be provided by the manufacturer in bay 3 which will be for control power, reverse power relay and for the SEL 735 meter
- 2. Provision for 3 VT's connected phase to ground shall be provided by the manufacturer in bay 2 for future reverse power relay and SEL 735 meter
- 3. 3 CT's with a 600:5 ratio shall be provided in bay 3 and wired to a SEL 735 meter and Basler 59-1 relay with cat # BE A6F-A1J-C2N0F with test switches.
- 4. Provision for 3 CT's with a 600:5 ratio shall be provided in bay 2 for future SEL 735 meter and reverse power relay.
- 5. The meters and relays shall be mounted on the door of each feeder bay.

K. Control Power

- 1. Control power shall be provided from the internal VT's.

L. IR Windows

- 1. 2 sets of IR windows shall be provided in each bay.

M. Lights

1. A light and light switch shall be provided in each bay.

N. Auxiliary contacts

1. Auxiliary contacts shall be provided for each motor operator.

2.5 FINISH AND FEATURES

A. Outdoor Switchgear

1. Outdoor Finish

- a. The enclosure finish shall conform to or exceed the applicable requirements of ANSI C57.12.28.
- b. During fabrication, the areas of structural parts which may later become inaccessible, such as folded edges and overlapping members, shall be given an iron-oxide zinc-chromate anticorrosion primer to ensure that all surfaces are protected.
- c. Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.
- d. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling before any protective coatings are applied. By utilizing an automated pretreatment process, the enclosure will receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.
- e. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the enclosure manufacturer's finishing system shall satisfactorily pass the following tests:
 - 1) 4000 hours of exposure to salt-spray testing per ASTM B 117 with:
 - a) Underfilm corrosion not to extend more than 1/32" from the scribe as evaluated per ASTM D 1654, Procedure A, Method 2 (scraping); and
 - b) Loss of adhesion from bare metal not to extend more than 1/8" from the scribe.
 - 2) 1000 hours of humidity testing per ASTM D 4585 with no blistering as evaluated per ASTM D 714.
 - 3) 500 hours of ultraviolet accelerated weathering testing per ASTM G 53 using lamp UVB-313 with no chalking as evaluated per ASTM D 659, and no more than a 10% reduction of paint gloss as evaluated per ASTM D 523.
 - 4) Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of paint.

- 5) 160-inch-pound impact adhesion testing per ASTM D 2794 with no paint chipping or cracking.
- 6) Oil resistance testing consisting of a 72-hour immersion bath in mineral oil with no shift in color, no streaking, no blistering, and no loss of hardness.
- 7) 3000 cycles of abrasion testing per ASTM 4060 with no penetration to the substrate.
- 8) Certified test abstracts substantiating the above capabilities shall be furnished upon request.
- h. A heavy coat of insulating "no-drip" compound shall be applied to the inside surface of the roof structure to prevent condensation of moisture thereon.
- i. After the enclosures are completely assembled and the components (switches, fuses, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches. Blemishes shall be touched up to restore the protective integrity of the finish.
- j. Touch-up materials—with complete instructions—shall be included with each shipment of metal-enclosed switchgear for touch-up in the field.
- k. The finish shall be light gray, satisfying the requirements of ANSI Standard Z55.1 for No. 61 or No. 70.

B. Outdoor Features

1. Enclosure Ventilation
 - a. Ventilation openings shall be provided at the top and bottom on the front and rear of each bay. Ventilation openings on the front of arc-resistant switchgear shall be provided at the top only.
 - b. Vents shall be rain-resistant and corrosion-resistant.
 - c. Each vent shall have an inside screen and baffle to exclude insects and to protect against insertion of foreign objects.
 - d. In consideration of exceptionally high concentrations of airborne dust, externally accessible glass-fiber filters shall be provided.
2. Lifting eyes shall be removable. Sockets for lifting eyes shall be blind-tapped.
3. Gasketing and Sealing
 - a. Door openings and openings for hinged bolted panels (and bolted panels providing access to low-voltage components) shall have resilient compression gasketing to prevent water from entering the enclosure.
 - b. Gasket seals shall be provided at the top and side edges of adjoining bays to prevent water entry between the double walls.
 - c. The top and both sides of bus openings between bays shall be covered with channel gaskets as an additional protection against entrance of water or external labyrinthine metal rainshields shall be provided over enclosure roof flanges between adjacent bays.
 - d. Roofs shall be weather-sealed in place with a suitable sealant.
4. Space Heaters
 - a. Space heaters with sheaths of high-temperature chrome steel shall be provided to maintain air circulation inside the enclosure.
 - b. There shall be a space heater in each bay.
 - c. Space heaters shall be wired.
5. Lights and light switches shall be provided in each bay.

2.6 BASIC COMPONENTS

A. Interrupter Switches

1. Interrupter switches shall have a one-time or two-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the switchgear. These ratings define the ability to close the interrupter switch either alone (unfused) or in combination with the appropriate fuse, once or twice (as applicable) against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substa
2. Initiating these ratings shall be performed at maximum voltage. Certified test abstracts establishing such ratings shall be furnished upon request.
3. Interrupter switches intended for manual operation shall be operated by means of an externally operable, nonremovable handle. The handle shall have provisions for padlocking in both the open and a closed positions. Interrupter switches intended for power operation shall be operated by means of a switch operator expressly designed to be compatible with the interrupter switch.
4. Interrupter switches shall utilize a quick-make quick-break mechanism installed by the switch manufacturer, which shall swiftly and positively open and close the interrupter switch independent of the switch-handle or switch operator operating speed.
 - a. For manually operated interrupter switches, and for interrupter switches operated by direct motor drive switch operators, the quick-make quick-break mechanism shall be integrally mounted to the switch frame.
 - b. For interrupter switches operated by stored-energy switch operators, the quick-make quick-break mechanism shall be an integral part of the switch operator.
5. Interrupter switches shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch, to positively isolate the load circuit when the interrupter switch is in the open position.
6. Interrupter switches shall be provided with a single blade per phase for circuit closing including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted.
7. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. Circuit interruption shall take place completely within the interrupter, with no external arc or flame. Any exhaust shall be vented in a controlled manner through a labyrinthine muffler or a deionizing vent.
8. Interrupter switches shall have a readily visible open gap when in the open position to allow positive verification of switch position.
9. Terminals on interrupter switches to which cable will be terminated shall be equipped with grounding provisions. Grounding provisions shall also be provided on the ground bus in such bays.
10. The bus tie switch shall be mounted to the roof of the switchgear bay and be in line with the bus.

B. Fuses

1. Solid-Material SM-40 Power Fuses without substitution
 - a. Solid-material power fuses shall be of the solid-material type and shall utilize refill-unit-and-holder or fuse-unit-and-end-fitting construction. The refill unit or fuse unit shall be readily replaceable.
 - b. For switchgear rated up through 600 MVA at 13.8 kv, mountings for solid-material power fuses shall be disconnect style. Non-disconnect style mountings for power fuses shall be used only where higher ratings are required.
 - c. Fusible elements shall be nonaging and nondamageable so that it is unnecessary to replace unblown companion fuses following a fuse operation.
 - d. Fusible elements for refill units or fuse units, rated 10 amperes or larger, shall be helically coiled to avoid mechanical damage due to stresses from current surges.
 - e. Fusible elements that carry continuous current shall be supported in air to help prevent damage from current surges.
 - f. Solid-material power fuses shall have melting time-current characteristics that are permanently accurate with a maximum total tolerance of 10% in terms of current. Time-current characteristics shall be available which permit coordination with protective relays, automatic circuit reclosers, and other fuses.
 - g. Solid-material power fuses shall be capable of detecting and interrupting all faults whether large, medium, or small (down to minimum melting current), under all realistic conditions of circuitry, with line-to-line or line-to-ground voltage across the power fuses, and shall be capable of handling the full range of transient recovery voltage severity associated with these faults.
 - i. All arcing accompanying power fuse operation shall be contained within the fuse, and any arc products and gases evolved during fuse operation shall be vented through exhaust control devices that shall effectively control fuse exhaust.
 - j. Solid-material power fuses shall be equipped with a blown-fuse indicator that shall provide visible evidence of fuse operation while installed in the fuse mounting.
 - k. Solid-material power fuses in feeder bays shall be equipped with grounding provisions on the load side of each fuse and on the enclosure ground bus.

C. Switch Operators

1. The following requirements apply to switch operators that incorporate an integral quick-make quick-break mechanism for solenoid trip-open and solenoid trip-closed operation with motor recharge—for use with interrupter switches rated 13.8 kV nominal, 600 amperes load interrupting or less.
 - a. Switch operators shall be of the stored-energy type. They shall be equipped with an integral quick-make quick-break mechanism installed by the switch operator manufacturer, which shall store sufficient mechanical energy to either open or close the interrupter switch. The quick-make quick-break mechanism shall swiftly and positively open and close the associated

interrupter switch independent of the speed of the charging motor or manual handle.

- c. Switch operators shall be equipped with a tripping solenoid to release the stored energy to open or close the associated interrupter switch in response to a control signal. Total operating time for opening or closing shall not exceed 4 cycles from the time the solenoid is energized.
- d. Switch operators shall be equipped with a charging motor that shall charge the quick-make quick-break mechanism within 1Z\x seconds after each switch operation.
- e. Switch operators shall be equipped with a torque limiter to absorb deceleration forces when travel limits are reached during charging to allow the motor to positively and completely charge the quick-make quick-break mechanism without transmitting excessive torque to the mechanism.
- f. Pushbuttons shall be provided to permit local electrical trip-open and trip-closed operation. Local electrical operation shall be prevented when the source-transfer control is in the automatic mode.
- g. Switch operators shall be provided with a manual charging access port and a removable manual-charging handle to allow manual charging of the quick-make quick-break mechanism in the absence of control power. While the manual charging access port is open, the motor-charging circuit shall be disconnected to prevent inadvertent electrical charging of the quick-make quick-break mechanism.
- i. Switch operators shall be equipped to permit local mechanical trip-open and trip-closed operation in the event control power is lost.
- j. Switch operators shall be located within a grounded, metal-enclosed low-voltage compartment in the switchgear stile, and shall be mounted on a drawout carriage. The metal-enclosed compartment shall provide isolation from high voltage to help protect operating personnel. The drawout carriage shall permit decoupling of the switch operator from the associated interrupter switch
- k. for testing and exercising of the switch operator without opening or closing the interrupter switch and without exposure to high voltage.
- l. When the switch operator is decoupled, the associated interrupter switch shall be locked open or closed, depending upon switch position at the time of decoupling. It shall not be possible to recouple the switch operator to the interrupter switch unless the switch operator is in the same position (open or closed) as the interrupter switch.
- m. Switch operators shall be equipped with targets to show whether the quick-make quick-break mechanism is charged or discharged; whether the switch operator is in the switch-open or switch-closed position; whether the associated interrupter switch is in the open or closed position; and whether the switch operator is in the coupled or decoupled position.
- n. Switch operators shall be equipped with an operation counter.
- o. Switch operators shall be provided with a hinged padlockable steel cover or door to protect the switch operators and to guard against tampering. The cover or door shall be equipped with windows (unless Category A enclosures are required) to allow observation of the switch operator

targets. Gasketing shall be installed between the cover or door and the mounting surfaces.

- p. Switch operators shall be equipped with an extra 4-PDT auxiliary switch coupled to the switch operator.
- q. A receptacle shall be provided for attachment of a remote-control station to allow electrical trip-open and trip-closed operation from an adjacent area.

D. Single-Phasing Protection on Ungrounded and Grounded Systems with a Specialty Current Detection Relay—Power-Operated Feeders

- 1. Specialty relays shall be provided for power-operated feeders to protect three- phase loads from Single Phasing conditions. The specialty relay shall trip the associated switch operator after a downstream fault has been cleared by the feeder fuse(s) or the source-side protective device.
- 2. Specialty relays shall employ proven solid-state electronic components and shall continuously monitor the current in each phase of the feeder circuit. Specialty relays shall be capable of distinguishing between transformer inrush current and fault current and produce a trip signal only on fault currents.
- 3. Specialty relays shall:
 - a. Use closed-gap current sensors to sense the current in each phase of the feeder circuit.
 - b. Include a TRIP indicator that displays a red target when the relay has operated. A pushbutton shall be provided to reset the TRIP indicator.
 - c. Provide for field adjustment of the trip-level detector setting over the range 400 to 2400 amperes. This setting shall determine the level of phase current above which the relay is to respond.
 - d. Include a PICKUP indicator lamp that illuminates when an overcurrent that exceeds the trip-level setting has been detected. The lamp shall extinguish after the relay has operated and shall have a Push to Test feature.
 - e. Include a field-adjustable delay timer for selecting the duration between detection of an overcurrent and initiation of a tripping operation as a means to confirm whether the overcurrent is momentary or permanent. The timer range shall be from 1 to 35 seconds.
 - f. Use, on detection of an overcurrent, a two-millisecond time delay before starting the field-adjustable 1- to 35-second tripping circuit timer to eliminate response to transient disturbances.
 - g. Include a field-selectable Inrush Restraint feature that shall inhibit relay response to overcurrents occurring during initial energization or during reclosing of a source-side protective device. The Inrush Restraint feature shall delay, for one second, the starting of the two-millisecond time relay.
 - h. Include an elapsed-time indicator lamp that illuminates when the delay timer times out. The lamp shall extinguish after the relay has operated and shall have a Push to Test feature.
 - i. Reset if normal load current of 3.5 amperes or greater returns on all three phases before the delay timer times out.

- j. Include test jacks to simulate proper functioning of the three-phase over-current relay in response to transformer inrush currents and fault currents and to permit verification of the pickup and trip levels as well as the trip-current timer setting. (These test jacks shall also permit verification of the proper functioning of the current sensors.)
- k. Use a blocking circuit to prevent tripping of the switch operator while the overcurrent exceeds 600 amperes.
- l. Mount in a grounded, metal-enclosed low-voltage compartment in the switch-gear stile. (The metal-enclosed compartment shall provide complete isolation from high voltage.)
- 5. The surge-withstand capability of all overcurrent relays shall be verified by subjecting each device to both the ANSI/IEEE Surge Withstand Capability Test (ANSI Standard C37.90.1) and to :
 - a. ANSI Standard C62.41 Category B Power Line Surge
- 6. Specialty relays shall use printed-circuit-board construction.

To ensure the high quality and reliability of the electronic components, all specialty relays shall be subjected to a dielectric test, a functional check, and a 48-hour screening test followed by a second functional test. For the screening test, the specialty relay shall be energized at rated control voltage while subjected to 48 hours of temperature cycling repeatedly between -40°C (-40°F) and 65°C (149°F).

2.7 LABELING

- A. Comply with requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Warning Signs
 - 1. All external doors and hinged bolted panels providing access to high voltage shall be provided with "Caution—High Voltage—Keep Out" signs.
 - 2. All internal protective screens providing access to high voltage shall be provided with "Danger—High Voltage—Keep Out—Qualified Persons Only" signs.
 - 3. All internal protective screens providing access to interrupter switches shall be provided with warning signs indicating that "Switch Blades May Be Energized in Any Position."
 - 4. All internal protective screens providing access to fuses shall be provided with warning signs indicating that "Fuses May Be Energized in Any Position."
- C. Rating Nameplates
 - 1. The integrated switchgear assembly shall be provided with an external nameplate indicating the manufacturer's drawing number and the following: voltage ratings (kV, nominal; kV, maximum; kV, BIL); main bus continuous rating (amperes); short-circuit ratings (amperes, RMS symmetrical and MVA three-phase symmetrical at rated nominal voltage); and the momentary and fault-closing ratings (amperes, RMS asymmetrical). When the assembly is UL listed, the external nameplate shall include the UL classification marking
 - 2. ssification

3. gs comprised of "UL" in a circle; the word "Listed"; the assigned control number; and the product identity.
4. Each individual bay shall bear a nameplate indicating the ratings of the interrupter switch (amperes, continuous and interrupting); the maximum rating of the fuse in amperes; and the catalog number of the fuse units, refill units, interrupting module, or control module. When the individual bay is to be UL listed, this nameplate shall include the UL classification markings comprised of "UL" in a circle; the word "Listed"; the assigned control number; and the product identity. In addition, the enclosure category shall be specified.

2.8 SOURCE QUALITY CONTROL

- A. Perform production tests on each circuit breaker housing for this Project, complying with IEEE C37.20.3:
 1. Perform mechanical operation tests to ensure proper functioning of shutters, operating mechanism, mechanical interlocks, and interchangeability of removable elements that are designed to be interchangeable.
 2. Verify that control wiring is correct by verifying continuity. Perform electrical operation of relays and devices to ensure they function properly and in the intended sequence.
 3. Perform the control wiring dielectric test at 1500 V for one minute.
- B. Perform production tests, on each circuit breaker supplied for this Project, complying with IEEE C37.20.4.
 1. Perform mechanical operation tests to ensure proper functioning of the switch.
 2. Verify the contact gap. Perform terminal-to-terminal resistance test.
 3. Verify that control wiring is correct by verifying continuity. Perform electrical operation of relays and devices to ensure they function properly and in the intended sequence.
 4. Perform the control wiring dielectric test at 1500 V for one minute.
- C. Owner will witness required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Upon delivery of switchgear and prior to unloading, inspect equipment for damage.
 1. Examine tie rods and chains to verify they are undamaged and tight and that blocking and bracing are tight.

2. Verify that there is no evidence of load shifting in transit and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Examine switchgear for external damage, including dents or scratches in doors and sill, and termination provisions.
4. Compare switchgear and accessories received with the bill of materials to verify that the shipment is complete. Verify that switchgear and accessories conform to the manufacturer's quotation and shop drawings. If the shipment is not complete or does not comply with project requirements, notify the manufacturer in writing immediately.
5. Unload switchgear, observing packing label warnings and handling instructions.
6. Open compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle switchgear according to manufacturer's recommendations; avoid damage to the enclosure, termination compartments, base, frame, tank, and internal components. Do not subject switchgear to impact, jolting, jarring, or rough handling.
2. Protect switchgear compartments against the entrance of dust, rain, and snow.
3. Transport switchgear upright to avoid internal stresses on equipment mounting assemblies. Do not tilt or tip switchgear.
4. Use spreaders or a lifting beam to obtain a vertical lift and to protect switchgear from straps bearing against the enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
5. Do not damage structure when handling switchgear.

C. Storage:

1. Store switchgear in a location that is clean and protected from weather. Protect switchgear from dirt, water, contamination, and physical damage. Do not store switchgear in the presence of corrosive or explosive gases.
2. Store switchgear with compartment doors closed.
3. Regularly inspect switchgear while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions.

D. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will have to cross section barriers to reach load or line lugs.

E. Pre-Installation Checks:

1. Verify removal of any shipping bracing after placement.

- F. Verify that ground connections are in place and that requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be [5 ohms] <Insert value> at switchgear location.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SWITCHGEAR INSTALLATION

A. Equipment Mounting:

- 1. Install switchgear on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
- 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 26 05 48 "Seismic Controls for Electrical Systems."
- 3. Comply with requirements for vibration isolation devices specified in Section 26 05 29 "Hangers and Supports for Electrical Systems."
- B. Switchgear shall be installed level and plumb. Switchgear shall tilt less than 1.5 degrees while energized.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Comply with NECA 1.
- E. Comply with NECA 430.

3.3 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Grounding Connections at Interior Locations:
 - 1. Install bare copper cable not smaller than No. 4/0 AWG for grounding to grounding electrodes.
 - 2. Bond surge arrester and neutrals directly to the switchgear enclosure and then to the grounding electrode system with bare copper conductors.
 - 3. Keep leads as short as practicable with no kinks or sharp bends.
 - 4. Make joints in grounding conductors and loops by exothermic weld or compression connector.
- C. Grounding Connections at Exterior Locations:
 - 1. Install tinned bare copper cable not smaller than No. 4/0 AWG, for counterpoise buried not less than **30 inches** (**765 mm**) below grade interconnecting the grounding electrodes.

2. Bond surge arrester and neutrals directly to the switchgear enclosure and then to the grounding electrode system with bare copper conductors, sized as shown.
 3. Keep lead lengths as short as practicable with no kinks or sharp bends.
 4. Fence and equipment connections shall not be smaller than No. 4 AWG.
 5. Ground fence at each gate post and corner post and at intervals not exceeding **10 ft. (3050 mm)**.
 6. Bond each gate section to the fence post using **1/8 by 1 inch (3 by 25 mm)** tinned flexible braided copper strap and clamps.
 7. Make joints in grounding conductors and loops by exothermic weld or compression connector.
- D. Terminate all grounding and bonding conductors on a common equipment grounding terminal on the switchgear enclosure. Install supplemental terminal bars, lugs, and bonding jumpers as required to accommodate the number of conductors for termination.
- E. Complete switchgear grounding and lightning arrester connections prior to making any other electrical connections.
- F. Terminate medium-voltage cables according to Section 26 05 13 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

- A. Comply with the installation requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install warning signs as required to comply with OSHA in 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. General Field Testing Requirements:
 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods."

2. After installing switchgear and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

F. Medium-Voltage Switchgear Assembly Field Tests:

1. Visual and Mechanical Inspection:
 - a. Verify that fuse and circuit breaker sizes and types correspond to Drawings and coordination study.
 - b. Verify that current and voltage transformer ratios correspond to Drawings.
 - c. Inspect bolted electrical connections using calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - d. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - 1) Attempt closure on locked-open devices. Attempt to open locked-closed devices.
 - 2) Make key exchange with devices operated in off-normal positions.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Inspect insulators for evidence of physical damage or contaminated surfaces.
 - g. Verify correct barrier and shutter installation and operation.
 - h. Exercise active components.
 - i. Inspect mechanical indicating devices for correct operation.
 - j. Verify that filters are in place and vents are clear.
 - k. Perform visual and mechanical inspection of instrument transformers according to Article "Instrument Transformer Field Tests."
 - l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit breaker ratings match drawings.
 - 3) Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.

2. Electrical Tests:

- a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections.

Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

- b. Perform dc voltage insulation-resistance tests on each bus section, phase to phase and phase to ground, for one minute. If the temperature of the bus is other than plus or minus 20 deg C, adjust the resulting resistance as provided in NETA ATS, Table 100 .11.
 - 1) Insulation-resistance values of bus insulation shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.1.
 - 2) Do not proceed to the dielectric withstand voltage tests until insulation-resistance levels are raised above minimum values.
- d. Perform a dielectric withstand voltage test on each bus section, each phase to ground with phases not under test grounded, according to manufacturer's published data. If manufacturer has no recommendation for this test, it shall be conducted according to NETA ATS, Table 100.2. Apply the test voltage for one minute.
 - 1) If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - 2) End the test.
- e. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 V dc for 600-V rated cable. Test duration shall be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - 1) Minimum insulation-resistance values of control wiring shall not be less than two megohms.
- f. Control Power Transformers:
 - 1) Perform insulation-resistance tests. Perform measurements from winding to winding and each winding to ground. Insulation-resistance values of winding insulation shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.1.
 - 2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and
 - 3) connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.

- 4) Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
- 5) Verify correct function of control transfer relays located in the switchgear with multiple control power sources.

g. Voltage Transformers:

- 1) Perform secondary wiring integrity test. Verify correct potential at all devices.
- 2) Verify secondary voltages by energizing the primary winding with system voltage.

h. Perform current-injection tests on the entire current circuit in each section of switchgear.

- 1) Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 A flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.
- 2) Perform current tests by primary injection with magnitudes such that a minimum of 1.0 A flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.

i. Perform system function tests according to "System Function Tests" Article.

j. Verify operation of space heaters.

k. Perform phasing checks on double-ended or dual-source switchgear to ensure correct bus phasing from each source.

G. Instrument Transformer Field Tests:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data complies with Contract Documents.
- b. Inspect physical and mechanical condition.
- c. Verify correct connection of transformers with system requirements.
- d. Verify that adequate clearances exist between primary and secondary circuit wiring.
- e. Verify the unit is clean.
- f. Inspect bolted electrical connections using calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- g. Verify that required grounding and shorting connections provide contact.
- h. Verify correct operation of transformer withdrawal mechanism and grounding operation.

- i. Verify correct primary and secondary fuse sizes for voltage transformers.
- j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

2. Electrical Tests of Current Transformers:

- a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- b. Perform insulation-resistance test of each current transformer and its secondary wiring with respect to ground at 1000 V dc for one minute. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's written recommendations.
- c. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.5.
- d. Perform a polarity test of each current transformer according to IEEE C57.13.1. Polarity results shall agree with transformer markings.
- e. Perform a ratio-verification test using the voltage or current method according to IEEE C57.13.1. Ratio errors shall be according to IEEE C57.13.
- f. Perform an excitation test on transformers used for relaying applications according to IEEE C57.13.1. Excitation results shall match the curve supplied by the manufacturer or be according to IEEE C57.13.1.
- g. Measure current circuit burdens at transformer terminals according to IEEE C57.13.1. Measured burdens shall be compared with and shall match instrument transformer ratings.
- h. Perform insulation-resistance tests on the primary winding with the secondary grounded. Test voltages shall be according to Table 100.5.
- i. Perform dielectric withstand tests on the primary winding with the secondary grounded. Test voltages shall be according to Table 100.9.
- j. Perform power-factor or dissipation-factor tests according to test equipment manufacturer's published data.
- k. Verify that current transformer secondary circuits are grounded and have only one grounding point according to IEEE C57.13.3. That grounding point should be located as specified by the engineer in the project drawings.

3. Electrical Tests of Voltage Transformers:

- a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests winding-to-winding and each winding to ground. Test voltages shall be applied for one minute according to Table 100.5. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer

- c. 's recommendations. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.5.
- d. Perform a polarity test on each transformer to verify the polarity marks or H1- X1 relationship as applicable. Polarity results shall agree with transformer markings.
- e. Perform a turns-ratio test on all tap positions. Ratio errors shall be according to IEEE C57.13.
- f. Measure voltage circuit burdens at transformer terminals. Measured burdens shall be compared with and shall match instrument transformer ratings.
- g. Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground. The dielectric voltage shall be according to Table 100.9. The test voltage shall be applied for one minute. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary windings are considered to have passed the test.
- i. Perform power-factor or dissipation-factor tests according to test equipment manufacturer's published data. Power-factor or dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, use test equipment manufacturer's published data.
- j. Verify that voltage transformer secondary circuits are grounded and have only one grounding point according to IEEE C57.13.3. Test results shall indicate that the circuits are grounded at only one point.

H. Ground Resistance Test:

1. Visual and Mechanical Inspection:

- a. Verify ground system complies with the Contract Documents and NFPA 70 Article 250, "Grounding and Bonding."
- b. Inspect physical and mechanical condition. Grounding system electrical and mechanical connections shall be free of corrosion.
- c. Inspect bolted electrical connections using a calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- e. Inspect anchorage.

2. Electrical Tests:

- a. Perform fall-of-potential or alternative test according to IEEE 81 on the main grounding electrode or system. The resistance between the main grounding electrode and ground shall be no more than [5 ohms] [maximum ground resistance value specified in "Examination" Article].

- b. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points. Investigate point-to-point resistance values that exceed 0.5 ohms. Compare equipment nameplate data with Contract Documents.
- c. Inspect physical and mechanical condition.
- d. Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

I. Metering Devices Field Tests:

1. Visual and Mechanical Inspection:

- a. Inspect physical and mechanical condition.
- b. Inspect bolted electrical connections using calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.
- c. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case shorting contacts, as applicable.
- d. Verify the unit is clean.
- e. Verify freedom of movement, end play, and alignment of rotating disk(s).

2. Electrical Tests:

- a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- b. Verify accuracy of meters at all cardinal points. Meter accuracy shall be according to manufacturer's published data.
- c. Calibrate meters according to manufacturer's published data. Calibration results shall be within manufacturer's published tolerances.
- d. Verify all instrument multipliers. Instrument multipliers shall be according to system design specifications.
- e. Verify that current transformer and voltage transformer secondary circuits are intact. Test results shall confirm the integrity of the secondary circuits of current and voltage transformers.

J. Medium-Voltage Surge Arrester Field Tests:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data complies with Contract Documents.

- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify the arresters are clean.
- e. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
- f. Verify that the stroke counter is correctly mounted and electrically connected if applicable. Record the stroke counter reading.

2. Electrical Test:

- a. Perform an insulation-resistance test on each arrester, phase terminal to ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to meet recommended minimum insulation resistance listed in the table.
- b. Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.
- c. Test grounding connections. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.

K. Microprocessor-Based Protective Relay Field Tests:

1. Visual and Mechanical Inspection:

- a. Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.
- b. Verify operation of light-emitting diodes, display, and targets.
- c. Record passwords for each access level.
- d. Clean the front panel and remove foreign material from the case.
- e. Check tightness of connections.
- f. Verify that the frame is grounded according to manufacturer's instructions.
- g. Set the relay according to results in Section 26 05 73 "Overcurrent Protective device coordination and arc flash analysis."
- h. Download settings from the relay. Print a copy of the settings for the report and compare the settings to those specified in the coordination study.

2. Electrical Tests:

- a. Perform insulation-resistance tests from each circuit to the grounded frame according to manufacturer's published data.
- b. Apply voltage or current to analog inputs, and verify correct registration of the relay meter functions.
- c. Functional Operation: Check functional operation of each element used in the protection scheme as follows:

1) Timing Relay:

- a) Determine time delay.

- b) Verify operation of instantaneous contacts.
- 2) Volts/Hertz Relay:
 - a) Determine pickup frequency at rated voltage.
 - b) Determine pickup frequency at a second voltage level.
 - c) Determine time delay.
- 3) Sync Check Relay:
 - a) Determine closing zone at rated voltage.
 - b) Determine maximum voltage differential that permits closing at zero degrees.
 - c) Determine live line, live bus, dead line, and dead bus set points.
 - d) Determine time delay.
 - e) Verify dead bus/live line, dead line/live bus, and dead bus/dead line control functions.
- 4) Undervoltage Relay:
 - a) Determine dropout voltage.
 - b) Determine time delay.
 - c) Determine time delay at a second point on the timing curve for inverse time relays.
- 5) Directional Power Relay:
 - a) Determine minimum pickup at maximum torque angle.
 - b) Determine closing zone.
 - c) Determine maximum torque angle.
 - d) Determine time delay.
 - e) Verify time delay at a second point on the timing curve for inverse time relays.
 - f) Plot the operating characteristic.
- 6) Current Balance Relay:
 - a) Determine pickup of each unit.
 - b) Determine percent slope.
 - c) Determine time delay.
- 7) Negative Sequence Current Relay:
 - a) Determine negative sequence alarm level.
 - b) Determine negative sequence minimum trip level.
 - c) Determine maximum time delay.
 - d) Verify two points on the I^2-t curve.
- 8) Phase Sequence or Phase Balance Voltage Relay:

- a) Determine positive sequence voltage to close the NO contact.
- b) Determine positive sequence voltage to open the NC contact (undervoltage trip).
- c) Verify negative sequence trip.
- d) Determine time delay to close the NO contact with sudden application of 120 percent of pickup.
- e) Determine time delay to close the NC contact upon removal of voltage when previously set to rated system voltage.

9) Instantaneous Overcurrent Relay:

- a) Determine pickup.
- b) Determine dropout.
- c) Determine time delay.

10) Time Overcurrent:

- a) Determine minimum pickup.
- b) Determine time delay at two points on the time current curve.

11) Ground Detector Relay:

- a) Determine maximum impedance to ground causing relay pickup.

12) Directional Overcurrent Relay:

- a) Determine directional unit minimum pickup at maximum torque angle.
- b) Determine closing zone.
- c) Determine maximum torque angle.
- d) Plot operating characteristics.
- e) Determine overcurrent unit pickup.
- f) Determine overcurrent unit time delay at two points on the time current curve.

d. Control Verification:

1) Functional Tests:

- a) Check operation of all active digital inputs.
- b) Check output contacts or silicone-controlled rectifiers (SCRs), preferably by operating the controlled device, such as circuit breaker, auxiliary relay, or alarm.
- c) Check internal logic functions used in protection scheme.
- d) Upon completion of testing, reset min/max recorders, communications statistics, fault counters, sequence-of-events recorder, and event records.

- 2) In-Service Monitoring: After the equipment is initially energized, measure magnitude and phase angle of inputs and verify expected values.

- L. Switchgear will be considered defective if it does not pass tests and inspections.
- M. Remove and replace defective units and retest.
- N. Prepare test and inspection reports. Record as-left set points of adjustable devices.

3.6 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
 - 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.

3.7 FOLLOW-UP SERVICE

- A. Voltage Monitoring and Adjusting: After Substantial Completion, but not more than six months after Final Acceptance, if requested by Owner, perform the following voltage monitoring:
 - 1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each switchgear. Use voltmeters with calibration traceable to NIST standards and with a chart speed of not less than **1 inch (25 mm)** per hour. Voltage unbalance greater than 1 percent between phases, or deviation of phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
 - 2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
 - a. Adjust switchgear taps.
 - b. Prepare written request for voltage adjustment by electric utility.
 - 3. Retests: Repeat monitoring, after corrective action has been performed, until specified results are obtained.
 - 4. Report:

- a. Prepare a written report covering monitoring performed and corrective action taken.
- B. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove covers prior to the inspection.
 1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of the switchgear.
 2. Instrument: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1deg C at 30 deg C.
 3. Record of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used and lists the results as follows:
 - a. Description of equipment to be tested.
 - b. Discrepancies.
 - c. Temperature difference between the area of concern and the reference area.
 - d. Probable cause of temperature difference.
 - e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
 - f. Identify load conditions at time of inspection.
 - g. Provide photographs and thermograms of the deficient area.
 4. Act on inspection results according to the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

(Part of Work of Section 26 00 01 – ELECTRICAL, Trade Bid Required)

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.
- B. Related Work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
- B.C. The switchboards (SWBD-1 and SWBD-GEN-1) have been pre-purchased by the Construction Manager. Refer to 26 00 01.1 for additional information and requirements regarding this equipment.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

B. Related Requirements

1. Section 26 05 73 "Overcurrent Protective Device Coordination Study and Arc Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.3 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. UL 486A Wire Connectors and Soldering Lugs for use with Copper Conductors
2. UL 489 Molded- Case Circuit Breakers and Circuit Breaker Enclosures
3. UL 891 Dead-Front Electrical Switchboards
4. ANSI C12 Code for Electricity Metering
5. ANSI C39.1 Requirements for Electrical Analog Indicating Instruments
6. ANSI C57.13 Requirements for Instrument Transformers
7. FS W-C-375 Circuit Breakers Molded Case, Branch Circuit and Service
8. NEMA AB 1 Molded Case Circuit Breakers
9. NEMA PB 2 Dead Front Distribution Switchboards
10. NEMA PB 2.1 Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or less

1.4 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 2. Provide a matrix including the following Switchboard name, Fed From, phase, voltage, current, wiring configuration, short circuit rating, schedule drawing number and room location.
- B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - a. Front, plan and side view elevations with overall dimensions.
 - b. Conduit entrance locations and requirements
 - c. Nameplate legends; size and number of bus bars per phase, neutral, and ground
 - d. Switchboard instrument details and accessories
 - e. Single line & schematic diagrams.
 2. Detail enclosure types for types other than NEMA 250, Type 1.
 3. Detail bus configuration, current, and voltage ratings.
 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 6. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
 7. Include schematic and wiring diagrams for power, signal, and control wiring.
 8. Submit manufacturer's installation instructions.
 9. Complete Bill of Material listing all components.

- C. The equipment selections used in the preparation of the Contract Documents will fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with Code requirements, the requirements of the Authorities Having Jurisdiction, and the equipment manufacturer's recommendations.
- D. In the preparation of Drawings, a reasonable effort to accommodate acceptable equipment manufacturer's space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for initial access, maintenance access, code required access, and proper fit rests with the Contractor.
- E. The work described in any shop drawing submission shall be carefully checked by this Contractor for all clearances, including those required for maintenance, servicing equipment removal, field conditions, maintenance of architectural conditions and proper coordination with all Trades on the job. Each submitted shop drawing shall include a certification by the Contractor that all related job conditions have been checked and that no conflict exists. No shop drawing submission will be reviewed without such certification.
- F. Delegated Design Submittal:

1. For arc-flash hazard analysis.
2. For arc-flash labels.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

- B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 10 00 "General Requirements," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on

translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than two of each size and type.
 - 4. Surge Protection Devices: For modular SPDs, provide one complete set of replacement SPD protection modules for each SPD installed, including all phase, neutral, and ground modules.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Switchboard components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no additional cost to the Owner's Representative. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle and prepare switchboards for installation according to NEMA PB 2.1 and manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

1.10 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F .
 - b. Altitude: Not exceeding 6600 feet .

1.11 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB/General Electric
 - 2. Eaton Cutler Hammer

3. Square D; by Schneider Electric.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
 1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- I. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current at rated voltage as noted on the drawings.
- J. Voltage and current ratings shall be as indicated on the drawings.
- K. Indoor Enclosures: Steel, NEMA 250, Type 1.
 1. Switchboards shall be fully self-supporting structures with 90 inch tall vertical sections (excluding lifting eyes and pull boxes) bolted together to form required arrangement.
 2. Switchboard frame shall be die formed, 12 gauge steel with reinforced corner gussets. Frame shall be rigidly bolted to support cover plates code gauge steel, bus bars and installed devices during shipment and installation. C. The assembly shall be provided with adequate lifting means.
 3. All sections may be rolled, moved or lifted into position. Switchboards shall be capable of being bolted directly to the floor without the use of floor sills.
 4. All switchboard sections shall have open bottoms and removable top plate(s) to install conduit.
 5. Front-Access only switchboard sections shall be front and rear aligned for placement against a wall.
 6. Switchboards shall be UL listed.
 7. All covers shall be fastened by hex head bolts.
 8. Provide hinged doors over metering compartments and individually mounted device compartments. All doors shall have concealed hinges and be fastened by hex head bolts.

9. Switchboard protective devices shall be furnished as listed on drawings and specified herein, including interconnections, instrumentation and control wiring.
10. Switchboard current ratings, including all devices, shall be based on a maximum ambient temperature of 25 degree C per UL Standard 891. With no derating required, temperature rise of switchboards and devices shall not exceed 65 degrees C in a 25 degree C ambient environment.
11. Mounting for the group mounted devices shall be by bolted connections. No plug-in type connections shall be used for current carrying components.

L. Enclosure Finish for Indoor Units:

1. All metal structural and unit parts shall be completely painted so that interior and exterior surfaces have a complete finish coat on and between them.
2. Enclosure shall be thoroughly cleaned, rinsed, pretreated with phosphatizing process followed by sealer rinses and rust inhibitor process and painting.
3. Paint shall be UL recognized acrylic, baked enamel ANSI-61 light gray.

M. Barriers: Between adjacent switchboard sections for emergency switchboards only.

N. Isolation for main and vertical buses of feeder sections.

O. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

P. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

Q. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated. The bus bars shall have sufficient cross-sectional area to meet UL 891 temperature rise requirements. Phase and neutral bus ampacity shall be as shown on the plans.
3. Bus bars shall be mounted on high impact, non-tracking insulated supports. Joints in the vertical bus are not permitted.
4. Bus bars shall be braced to withstand mechanical forces exerted during short circuit conditions as indicated in drawings, but in no case less than 65KA RMS SYM.
5. Bus joints shall be bolted with high tensile steel Grade 5 bolts. Welded connections are unacceptable.
6. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.
7. All feeder device line and load connection straps shall be rated to carry current rating of device frame not trip rating.
8. The main incoming bus bars shall be rated for the main overcurrent protection device switch or frame size and not less than the main incoming conductors.
9. Copper feeder circuit-breaker line connections.

10. Load Terminals: Rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 11. Ground Bus shall be sized to meet UL 891. Ground bus shall extend full length of switchboard. Ground bus shall be copper hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 12. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 13. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 14. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 15. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- R. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB (Electrification Products Division).
 2. Eaton.
 3. Square D; by Schneider Electric.
- B. The SPD shall be listed as Type 1 SPD, suitable for use in UL 1449, Type 1 OR Type 2 applications.
- C. Surge Protection Device Description: Modular design with field-replaceable module mounted externally to the Switchboard, with EMI Filtering (also known as sine-wave-tracking) type with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity (AIC).
 2. Fabrication using bolted compression lugs for internal wiring.
 3. Integral disconnect capable of passing full rated surge current, or dedicated fuse or breaker.
 4. Multiple suppression circuits with current sharing.
 5. Field Replaceable protection module.
 6. Utilizing wire connections to phase buses, neutral bus, and ground bus.
 7. LED indicator lights for power and protection status.
 8. Monitoring system capable of indicating the number of transient surges, over voltages, under voltage events.

9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. Dual set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with the building power monitoring and control system.
11. Field testable with test data from factory provided for comparison
12. Senses percentage of protection available indicating true protection level available
13. Monitors neutral-to-ground voltage and current

D. Peak Surge Current Rating:

1. 480/277V switchboards, 1200A or larger: 240 kA

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 800 V for 480Y/277 V.
2. Line to Ground: 800 V for 480Y/277 V.
1. Line to Line: 800 V for 480Y/277 V.

F. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Main Devices

1. Main device 1200 Amps and larger shall be individually mounted, manually operated, stationary mounted and insulated case circuit breaker.
2. All circuit protective devices shall have the following minimum symmetrical current interrupting capacity: 100kA or as listed on the contract drawings.

B. Feeder Devices

1. Feeder devices shall be group mount molded case circuit breakers.
2. Circuit breakers shall have digital electronic trip functions where indicated on the drawings.
3. Adjustable magnetic trip setting for circuit-breaker frame sizes 200 amps and smaller.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Furnish RMS Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting. Adjustable magnetic trip setting for circuit-breaker frame sizes 125 A and smaller.

3. Group mounted breakers shall be connected to the vertical bus by bolted connections.
4. Individually mounted molded case circuit breakers shall be stationary mounted.
5. Circuit breaker frames shall be constructed of a high-strength, molded, glass-reinforced polyester case and cover. Breakers shall have an overcenter, toggle handle-operated, trip free mechanism with quick make, and quick break action independent of the speed of the toggle handle operation. The design shall provide common tripping of all poles. Breakers shall be suitable for reverse feeding.
6. Breakers shall have ON and OFF position clearly marked on escutcheon. Breakers shall include a trip-to-test means on the escutcheon for manually tripping the breaker and exercising the mechanism and trip latch.
7. Breakers shall include factory installed mechanical lugs. Lugs shall be UL listed and rated 75 degrees C.
8. Where indicated on drawings, circuit breakers shall have digital electronic trip functions with the following characteristics:
 - a. Furnish digital electronic trip units as specified below.
 - b. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.
 - c. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and $I^2 t$ response where indicated on contract drawings.
 - d. As a minimum, the trip unit shall include the following features:
 - 1) Long time and short time protective functions shall have true RMS sensing technology.
 - 2) Ground fault protective function, if provided, shall contain a memory circuit to integrate low level arcing fault currents with time, to sum the intermittent ground fault spikes.
 - a) High contrast liquid crystal display (LCD) unit shall display settings, trip targets, and the specified metering displays.
 - b) Multi-button keypad to provide local setup and readout of all trip settings on the LCD.
 - c) UL Listed interchangeable rating plug. It shall not be necessary to remove the trip unit to change the rating plug.
 - d) An integral test jack for testing via a portable test set and connection to a battery source.
 - e) A mechanism for sealing the rating plug and the trip unit.
 - f) Noise immunity shall meet the requirements of IEEE C37.90.
 - g) Display trip targets for long time, short time, and ground fault, if included.

3) Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

9. Current-Limiting Circuit Breakers: Frame sizes 200A and smaller; let-through ratings less than NEMA FU 1, RK-5.
10. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
11. MCCB Features and Accessories:
 - a. Lugs: Mechanical style, suitable for number and size of conductors indicated on the single line diagram, trip ratings, and conductor material.
 - b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator where indicated on contract drawings.
 - d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - e. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

D. Insulated-Case Circuit Breaker (ICCB): Cutler-Hammer type Magnum SBSE or approved equal, fuse-less current limiting type with fast opening 100 percent rated, sealed, insulated-case power circuit breaker with 200,000-ampere rms symmetrical interrupting capacity rating or as noted on drawing to meet available fault current.

1. Draw-out circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Each circuit breaker shall be equipped with a solid-state tripping system consisting of three (3) current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time/current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
4. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Time adjustments for long- and short-time pickup.
 - c. Ground-fault pickup level, time delay, and I squared t response where indicated on drawings
5. Remote trip indication.
6. Control Voltage: 120-V ac.

7. Breakers shall be constructed of a high dielectric strength, glass reinforced insulating case. The interrupting mechanism shall be arc chutes. Steel vent grids shall be used to suppress arcs and cool vented gases. Inter-phase barriers shall isolate completely each pole.
8. Breakers shall contain a true two-step stored energy operating mechanism which shall provide quick make, quick break operation with a maximum five cycle closing time. Breakers shall be trip free at all times. Common tripping of all poles shall be standard.
9. A charging handle, close push-button, open push-button, and Off/On/Charge indicator shall be located on the breaker escutcheon and shall be visible with the breaker compartment door closed.
10. To ensure a selective system, all circuit breakers shall have 30-cycle short-time withstand ratings equal to 18 times their frame ratings. Insulated case circuit breakers without an instantaneous trip element adjustment shall be equipped with a fixed internal instantaneous override set at that level.

2.4 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.5 IDENTIFICATION

- A. Equipment Identification Description, refer to Section 26 05 53.
- B. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:
 - 0-1. Frame size of each circuit breaker.
 - 0-2. Trip rating for each circuit breaker.
 - 0-3. Conduit and wire size for each feeder.
- C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices, refer to drawings for requirement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches (50-mm) above concrete base after switchboard is anchored in place.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

- E. Install filler plates in unused spaces of panel-mounted sections. All switchboard spaces shall be provided with bussing and hardware required for future circuit breaker attachment
- F. Install overcurrent protective devices, surge protection devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Comply with NECA 1.

3.3 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 4. All breakers shall be tested at the settings specified in approved Coordination Study by primary injection method per NETA ATS.
 5. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 6. Perform the following infrared scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Submit final report for review prior to project closeout and final acceptance by the owner. Include notation of test dates, devices tested, deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 Coordination Studies.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION

SECTION 26 32 13**DIESEL EMERGENCY ENGINE GENERATORS****(Part of Work of Section 26 00 01 – ELECTRICAL, Trade Bid Required)****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.
- A-B. The diesel emergency engine generator has been pre-purchased by the Construction Manager. Refer to 26 00 01.1 for additional information and requirements regarding this equipment.

1.2 SUMMARY

- A. This Section includes packaged engine-generator set for NFPA-110 Level 1 emergency power supply with the following features:
1. Diesel engine/generator set.
 2. Unit-mounted cooling system.
 3. Unit-mounted control and monitoring.
 4. Performance requirements for sensitive loads.
 5. Free Standing load bank.
 6. Outdoor sound attenuated weather protective factory skin-tight enclosure.
- B. Related Sections include the following:
1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
 2. Section 262416 "Panelboards" for enclosure integrated panelboard.

1.3 DEFINITIONS:

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 1. Thermal damage curve for generator.
 2. Time-current characteristic curves for generator protective device.
- 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. Dimensioned outline plan and elevation drawings of engine-generator, enclosure, and other components specified.
 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Performance Calculations: Provide manufacturer's calculation for engine and alternator sizing based on actual loads to be served. Calculation shall clearly show that the engine/generator set meets the performance requirements indicated. Contractor shall provide information on motor starting characteristics for actual products submitted by the mechanical contractor.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer, and testing agency.
- B. Source quality-control test reports.
 1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 4. Report of sound generation.
 5. Report of exhaust emissions showing compliance with applicable regulations.
 6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 2. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site. All service technicians shall be factory certified, and have been trained and certified NFPA 101 Life Safety and OSHA 10 Card
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASME B15.1.

- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- K. Noise Emission: Comply with applicable state and local government requirements, but as a minimum, the resultant sound level of the generator and enclosure, shall not noise level as indicated in Section 2.9 Q. Noise Criteria.

1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C. Relative Humidity: 0 to 95 percent.
 - 2. Altitude: Sea level to 1000 feet (300 m).

1.10 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. SteelCast Steel support angles into concrete base to ensure level mounting. Ensure steel beams are level prior to installation. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components including load bank and enclosure that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.
 - a. There shall be no deductible cost to the owner or any warranty registration fees.
 - b. The warranty shall include all costs associated with providing and installing a temporary generator set should a repair take longer than 48 hours. A rigging allowance shall also be included and documented in the factory warranty statement should it become necessary to remove the unit from the site for repair due to a catastrophic failure.

1.12 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment. Engine fluid sampling and analysis shall also be included annually. Provide option to extend the maintenance contract for a period of 5 years after the expiration of the initial maintenance agreement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Caterpillar, Inc.
 2. Cummins Inc.
 3. Rehlko (Kohler Energy)
 4. Generac Power Systems

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated on drawings
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance for Sensitive Loads:
1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance provided that it does not exceed DOE motor rating requirements.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil. Ultra Low Sulfur Diesel (ULSD)
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Provide isolation valves.

- G. Governor: Product of the engine manufacturer, adjustable electronic isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 4. The radiator shall carry an ambient rating of 120 degrees F based on a seven degree temperature rise across the engine, and shall be based on a maximum of a .5" of WC static pressure on the radiator face.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz, but may be higher as required to meet overall sound criteria as indicated in section 2.9.
 2. Sound level measured at a distance of 50 feet (3 m) from exhaust discharge in any horizontal direction after installation is complete shall be 70 dBA or less.
 3. The silencer shall be internally mounted and insulated inside the enclosure and shall include a condensation drain that is piped to the side wall of the enclosure with a manual maintenance valve for periodic draining. The valve shall be located in an easily accessible location within the enclosure.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Dual heavy-duty units that automatically engage and release from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer based on battery location within enclosure. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with all Federal and State regulations.
- B. Comply with NFPA 30.
- C. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 23 11 13 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- D. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- E. Fuel Filtering: Provide all-in-one, high performance, fuel/water separator designed for common rail fuel system. Filter shall be mounted between the supply line of the fuel tank and the diesel engine, with minimum efficiency of 99.9% at 7 microns. Fuel filter shall have a fuel clog level indicator and a Water-In-Fuel (WIF) sensor. The performance of the fuel filter shall meet or exceed this efficiency and be suitable for the engine manufacturer's requirements.

F. Subbase-Mounted, Double-Wall, Day Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Reverse fuel pump to be included.
2. Runtime: minimum of 8 hours while operating at full load
3. Tank level indicator: mechanical gauge
4. Leak detection in interstitial space.
5. Low fuel alarm
6. High fuel alarm
7. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. A remote panel shall also be provided as indicated on the drawings to provide remote monitoring/annunciation of all systems.
- C. Local Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter (non-resetting type).
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Start-stop switch.
 11. Overspeed shutdown device.
 12. Coolant high-temperature shutdown device.
 13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.

- D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- E. Provide dedicated customer use RS-485 modbus RTU communications port. Provide all data converters as necessary to facilitate communication between generator and BAS system. Provide access to the following information to the BAS system:
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
 6. Engine high-temperature shutdown.
 7. Lube-oil, low-pressure shutdown.
 8. Overspeed shutdown.
 9. Remote emergency-stop shutdown.
 10. Engine high-temperature prealarm.
 11. Lube-oil, low-pressure prealarm.
 12. Fuel tank, low-fuel level for both main and belly tanks.
 13. Low coolant level.
 14. Generator supplying load.
 15. Generator breaker trip or open.
 16. Generator ground fault alarm.
 17. Fuel overflow/critical high level alarm.
- F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
 6. Engine high-temperature shutdown.
 7. Lube-oil, low-pressure shutdown.
 8. Overspeed shutdown.
 9. Remote emergency-stop shutdown.
 10. Engine high-temperature prealarm.
 11. Lube-oil, low-pressure prealarm.
 12. Fuel tank, low-fuel level for both main and belly tanks.
 13. Low coolant level.
 14. Generator supplying load.
 15. Generator breaker trip or open.
 16. Generator ground fault alarm.
 17. Fuel overflow/critical high level alarm.
- G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push buttons shall be protected from accidental operation and located as indicated.
1. Shipped loose for contractor installation at closest roof access door to the generator enclosure.

2. On exterior of generator enclosure readily accessible from closest access point on roof. Switch shall be installed by generator enclosure manufacturer.
3. (2) Shipped loose for contractor installation in the fire command center

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Disconnect Switch: Molded-case type, 100 percent rated.
 1. Rating: Matched to generator output rating.
 2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
 3. Auxiliary and Bell Alarm: Provide contacts for annunciation on the generator control and remote annunciator panel that the generator unit mounted circuit breaker has been tripped or opened.
- B. Generator Overcurrent Protective Relay: Provide a UL listed / CSA certified generator protection relay integrated with the generator control system, coordinated with the alternator to prevent damage to the generator set on overload or fault conditions external to the machine.

The protective relay shall provide the following functions, as a minimum:

1. Overvoltage (59): Phase overvoltage shutdown, adjustable 105–125% of nominal with 0.1–10 s adjustable delay.
 2. Undervoltage (27): Phase undervoltage shutdown, adjustable 50–95% of nominal with 2–20 s adjustable delay.
 3. Underfrequency (81U): Adjustable 2–10 Hz below nominal with 5–20 s delay.
 4. Overfrequency (81O): Adjustable 2–10 Hz above nominal with 1–20 s delay.
 5. Overcurrent / thermal protection: Adjustable long-time protection based on alternator thermal damage curve; no instantaneous trip required.
 6. Loss of sensing voltage shutdown.
 7. Field overload shutdown.
 8. Overload (kW) warning.
 9. Reverse power (32): Adjustable 5–20% of rated kW with time delay.
 10. Reverse VAR protection: Adjustable 15–50% of rated VARs with time delay.
 11. Short-circuit protection coordinated to prevent alternator damage while permitting downstream protective device operation.
 12. Maintenance / arc-flash reduction mode: Provision for a maintenance mode that reduces incident energy at the generator terminals by increasing sensitivity or speed of protective functions, in compliance with NEC 240.87 where applicable.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

- C. Electrical Insulation: Class H .
- D. Temperature Rise: 105 degree C over 40 degree C ambient.
- E. Stator-Winding Leads: Provide random wound windings to ensure performance and reduce waveform harmonic distortion caused by non-linear loads such as UPS's and high pulse VFD's. The windings shall be brought out to terminal box to permit future reconnection for other voltages if required..
- F. Generator shall be capable of accepting a single-step load equal to at least 70% of the generator's nameplate kVA rating, with voltage recovery to a minimum of 90% rated no-load voltage within 1.0 second, in accordance with NEMA MG1.
- G. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- H. Enclosure: Driproof.
- I. Instrument Transformers: Mounted within generator enclosure.
- J. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- K. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- L. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- M. Subtransient Reactance: 11 percent, maximum.

2.8 LOAD BANK

- A. General: An engine radiator airflow cooled, resistive load bank is required for permanent, on site installation as a free-standing unit. The load bank shall be designed for local, automatic control.
- B. Electrical Connection: Power source to load bank connection is 3-phase, 3-wire plus ground. Additional control wire connections for remote control as required.
- C. Load Bank Rating:
 - 1. Capacity: 50% generator load, 1.0 p.f.
 - 2. Load Steps 50 KW load step resolution.
 - 3. Voltage: 480V AC, 3-ph., 3-W.
 - 4. Frequency: 60 Hertz.
 - 5. Air intake temperature: 155°F maximum (radiator air outflow).
 - 6. Airflow requirements: Radiator air outflow.
 - 7. Duty Cycle: Continuous.

8. Air temp. rise: 100°F, nominal.
9. Air back pressure: .25-50" water column.

D. Load Bank Design:

1. General: The load bank shall be a completely self-contained unit which includes all resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, control terminals, system protection devices and enclosure of required type.
2. The load bank shall be the manufacturer's standard product that has been investigated, tested and listed by Underwriters Laboratories as a system for the purpose intended.
3. Enclosure: Type 3R, welded sheet steel, UL approved finished painted consisting of an epoxy primer and a polyurethane top coat, consisting of a power section, for installation and wiring of the load elements and a control section for installation and wiring of control components. The control section is to be physically and thermally isolated from both the hot load elements and the heated airflow. Mounting adapters suitable for the installation method selected shall be supplied with the load bank. The exhaust of the load bank shall be screened and, if installed outdoors, louvers shall be provided.

E. Load elements: Load elements shall be UL listed, labeled or recognized. Helically wound, chromium alloy, thermally derated to 60%. 5% tolerance, 2% balance. .995 p.f. element wire mechanically supported over entire length such that if a wire should break, the broken wire segments will not short to adjacent conductors or to ground. Load elements are individually serviceable and replaceable in the field without major disassembly of the load bank.

F. Load element short circuit protection: Branch circuit fuses, per each 50KW load branch circuit. Fuses shall be 200,000 A.I.C current limiting type.

G. Load control: One magnetic contactor per each fused branch circuit.

H. Load Bank Power Wiring: 150°C insulated.

I. Control Wiring: 105°C insulated.

J. Control power shall be derived internally from the main load bus. Control and protective circuits shall operate at 120V via control power transformer or line-neutral circuit and shall be fused. All power wiring shall be connected to the generator enclosure panelboard.

K. System protection: The load bank shall include a comprehensive protection system to protect against overheating. The system shall function to disconnect the load elements from the power source and activate an alarm upon sensing a loss of cooling airflow, or an exhaust air temperature greater than 300°F.

L. Automatic disconnection: The load bank shall include automatic disconnection operation to immediately disconnect the load bank from the generator in a safe manner in order to facilitate connection of emergency loads. The automatic disconnection shall be interconnected with the ATS control system.

M. Local Control Panel:

1. A type 1 control panel for automatic and manual operation shall be provided. The panel shall include:
 - a. Control power on-off push-buttons
 - b. "Normal operation" indicator lamp
 - c. Master load control switch
 - d. Load step control switches
 - e. "Cooling failure" alarm indicator lamp
 - f. Remote control panel shall be UL listed.

N. Remote Control Panel:

1. Remote control of the load bank shall be provided by the remote ATS control panel.

O. Noise Criteria

1. Noise Criteria: The load bank unit with its integral enclosure shall produce a sound pressure level no more than 78 dBA at a distance of 23 ft in any horizontal direction from the unit, at an elevation about equal to the top of the unit, in a free field condition. This noise emission limit shall specifically include noise emissions from the casing panels, air inlet, air discharge, and engine exhaust, and this shall be made clear as part of a submittal. The supplier shall provide at the submittal stage, evidence to support their claim of meeting this requirement such as measurement data for a similar package or calculations that a person knowledgeable in noise control can follow

2.9 OUTDOOR SOUND ATTENUATED FACTORY SKIN-TIGHT GENERATOR-SET ENCLOSURE

- A. Description: UL-2200 listed sound attenuated, skin-tight, pre-engineered aluminum-clad with integral structural-steel frame enclosure package. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

1. Sound Attenuation Level: When installed and operating at rated load, the generator set and enclosure shall not exceed 74.1 dBA at 23 feet in a free-field condition.

- B. Description: Pre-fabricated or pre-engineered, aluminum-clad, integral structural-steel-framed, erected on concrete foundation.

- C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads of up to 150 mph.

- D. The combined height of the generator base rails, sub-base day tank, and enclosure threshold shall be limited such that no stairs, ladders, or elevated platforms are required to safely access, operate, or maintain the generator set or enclosure in compliance with applicable OSHA requirements (29 CFR 1910 Subpart D), NFPA 110, and AHJ standards.

1. The vendor shall provide a sub-base configuration that allows all routine maintenance activities—including checking fluids, draining fluids, replacing filters, operating the output breaker, operating local controls, and accessing doors and panels—to be performed from finished grade, without the need for elevated means of access.
 2. If the proposed sub-base height would necessitate an elevated working surface or stair access under OSHA rules, the vendor shall revise the sub-base design so the generator can be fully maintained from grade level.
- E. Finish: Zinc phosphate pre-treatment, e-coat primer and super durable powder topcoat paint to minimize corrosion and color fade. Manufacturer's standard finish color.
- F. Cambered roof to prevent water accumulation.
- G. Hinged Doors: Recessed lockable doors on both side of the unit. Include retainers to hold doors open for easy access. Each door must have a drip rail over to divert running rain water away from the doors.
- H. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- I. Non-hydroscopic sound attenuating enclosure lining material.
- J. Interior acoustic insulation shall be covered with a durable, factory-applied protective scrim or facing suitable for service in a generator enclosure and compliant with UL 2200.
- K. Muffler Location: Within enclosure.
- L. Space Heater: Thermostatically controlled and sized to prevent condensation
- M. Automatic Dampers: At engine cooling-air inlet and discharge louver dampers. Both air intake & air discharge dampers shall be motor closed/spring open to reduce enclosure heat loss in cold weather when unit is not operating. Should the damper motor fail the dampers should automatically open.
- N. Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure AC electrical features, including"
1. AC load distribution panelboard inside the generator enclosure connected to a 120/208 volts AC – 3-phase utility service by the installer.
 - a. Factory wired normal AC service from the panelboard to the engine coolant heater, alternator heater, battery charger, AC lights and automatic open/close louver dampers, convenience outlets.

2.10 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Enclosure manufacturer's standard color as selected by Architect over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator, load bank, and enclosure and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests in addition to any standard manufacturer's tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.

2. 1 hour full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing in 10% steps up to full load.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.
10. Verification of enclosure sound level performance.
11. Any additional tests which may be required by the Commissioning Agent.
12. Owner will witness all required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.
13. Contractor shall provide all flights, lodging, transportation, and meals required for (4) owner's representatives to witness the factory testing described above.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Prior to installation complete and submit all required Massachusetts State permitting forms including but not limited to the Massachusetts Department of Environmental Protection Installation Compliance Certification for New Emergency Engines. Obtain all approvals from Massachusetts State and the City of Worcester prior to starting-up generator.
- B. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Install packaged engine generator on cast-in-place concrete equipment bases where shown on grade. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 1. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

2. Comply with requirements for vibration isolation devices specified in this section.
- E. Install roof-mounted generators on rooftop dunnage provided by others. Coordinate mounting and support points with dunnage design.
- F. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Section 232116 Hydronic Piping Specialties."
 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section 232116 Hydronic Piping Specialties."
- G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect cooling-system water piping to engine-generator set and with flexible connectors.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Connect fuel piping to engines with a gate valve and union and flexible connector.
 1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 - 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 - 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 - 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Provide all fuel required for complete testing and any re-testing required. Generator fuel storage tank and belly tank shall be provided full of fuel at completion and acceptance of project.
- L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCHES

(Part of Work of Section 26 00 01 – ELECTRICAL, Trade Bid Required)

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.
- B. The automatic transfer switches have been pre-purchased by the Construction Manager. Refer to 26 00 01.1 for additional information and requirements regarding this equipment.

1.2 SUMMARY

- A. Section includes automatic transfer switches rated 600 V and less, including the following:
 - 1. Bypass/isolation switches.
 - 2. Remote annunciator system.
 - 3. Remote annunciator and control system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.

3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 011000 "General Requirements," include the following:
 - a. Features and operating sequences, both automatic and manual.
 - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 1. Member company of NETA.
 - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes

shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

- K. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via front and/or side access.
- N. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. ASCO Power Technologies; by Schneider Electric.
 - 2. Eaton
 - 3. Russelectric, Inc.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 - 4. Conductor Connectors: Suitable for use with conductor material and sizes.

5. Material: Hard-drawn copper, 98 percent conductivity.
 6. Main and Neutral Lugs: Mechanical type.
 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 8. Ground bar.
 9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds. For Legally Required ATS only.
- G. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- H. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to
13. 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

I. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2.3 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 - a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent

- transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
- b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
 - c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
 - d. Transition: Provide open-transition operation when transferring between power sources.
 - e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
 - f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 - g. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
 - h. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
 - i. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
 - j. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.
- B. Remote Annunciator System:
- 1. Source Limitations: Same manufacturer as transfer switch in which installed.
 - 2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
 - 3. Annunciation panel display shall include the following indicators:
 - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - b. Switch position.
 - c. Switch in test mode.
 - d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
- a. Indicating Lights: Grouped for each transfer switch monitored.

- b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
- c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
- d. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency and legally required systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.
 - i. Contact opening.
 - j. Endurance.
 - k. Short circuit.
 - l. Short-time current capability.
 - m. Receptacle withstand capability.
 - n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 3. Provide workspace and clearances required by NFPA 70.

- B. Announcer and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."
- G. Route and brace conductors according to manufacturer's written instructions[.] and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- H. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- I. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.
 - l. Inspect control power transformers:
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.

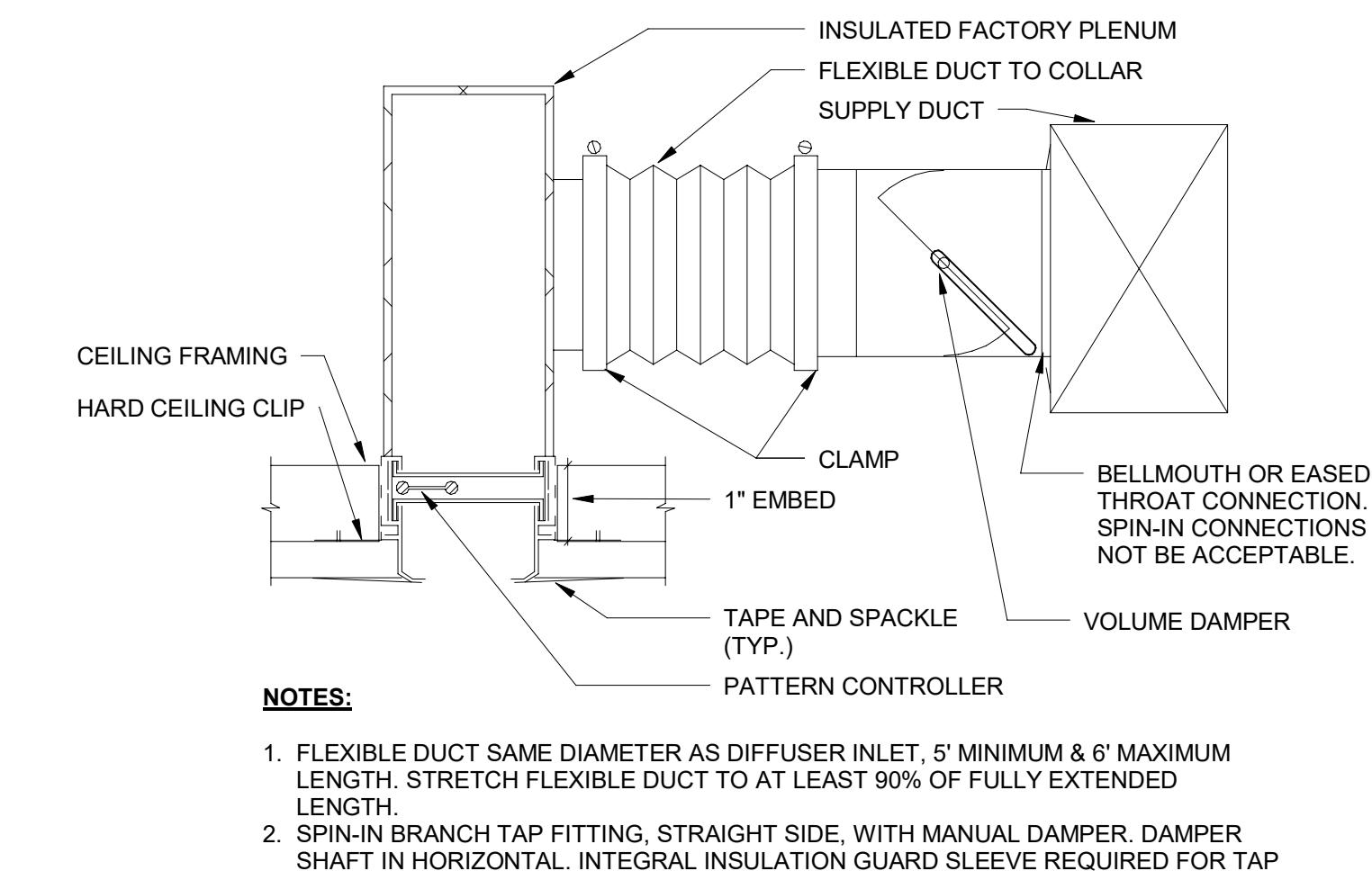
- 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
 - B. Coordinate tests with tests of generator and run them concurrently.
 - C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
 - D. Transfer switches will be considered defective if they do not pass tests and inspections.

- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.
- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

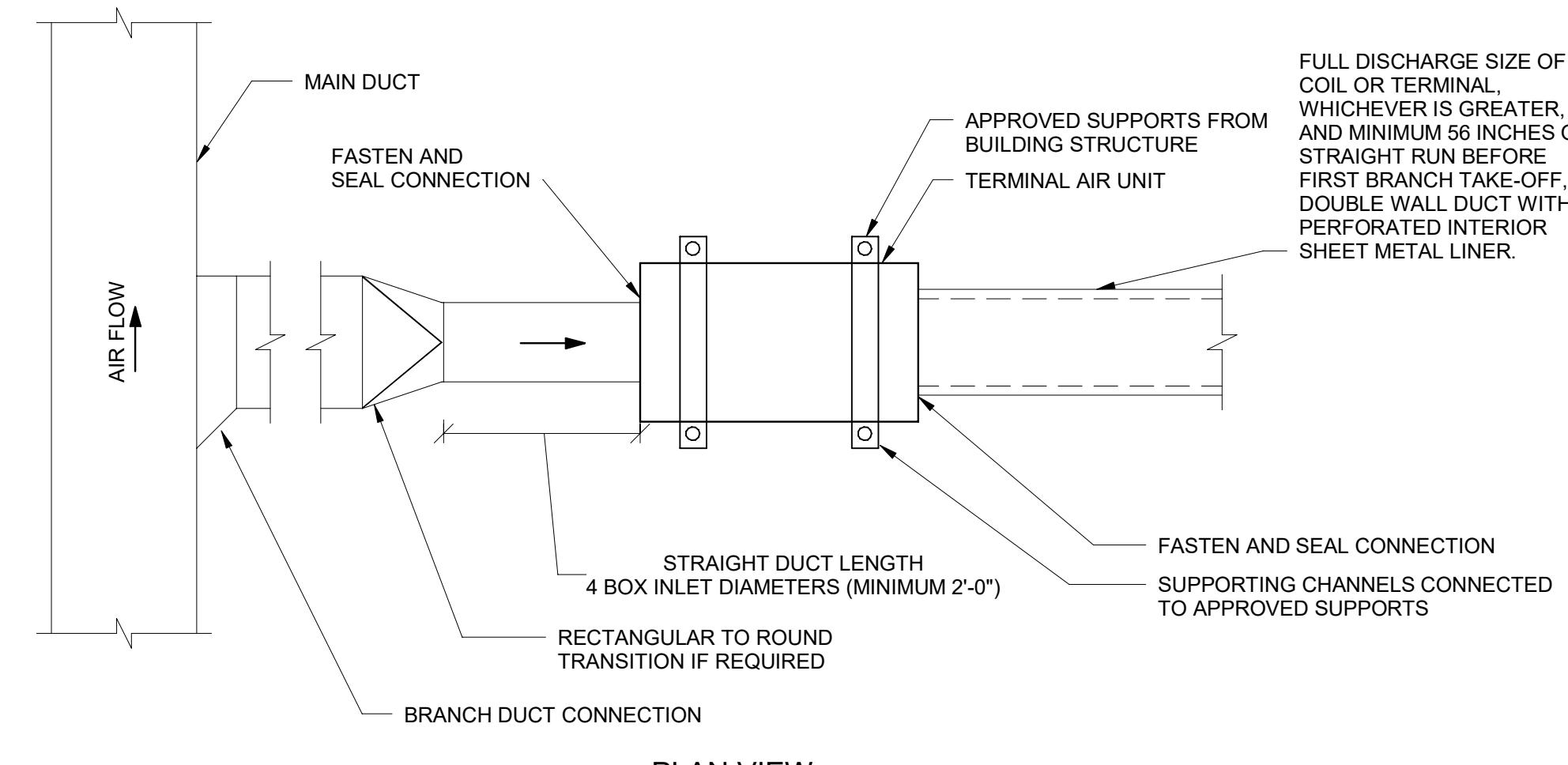
3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

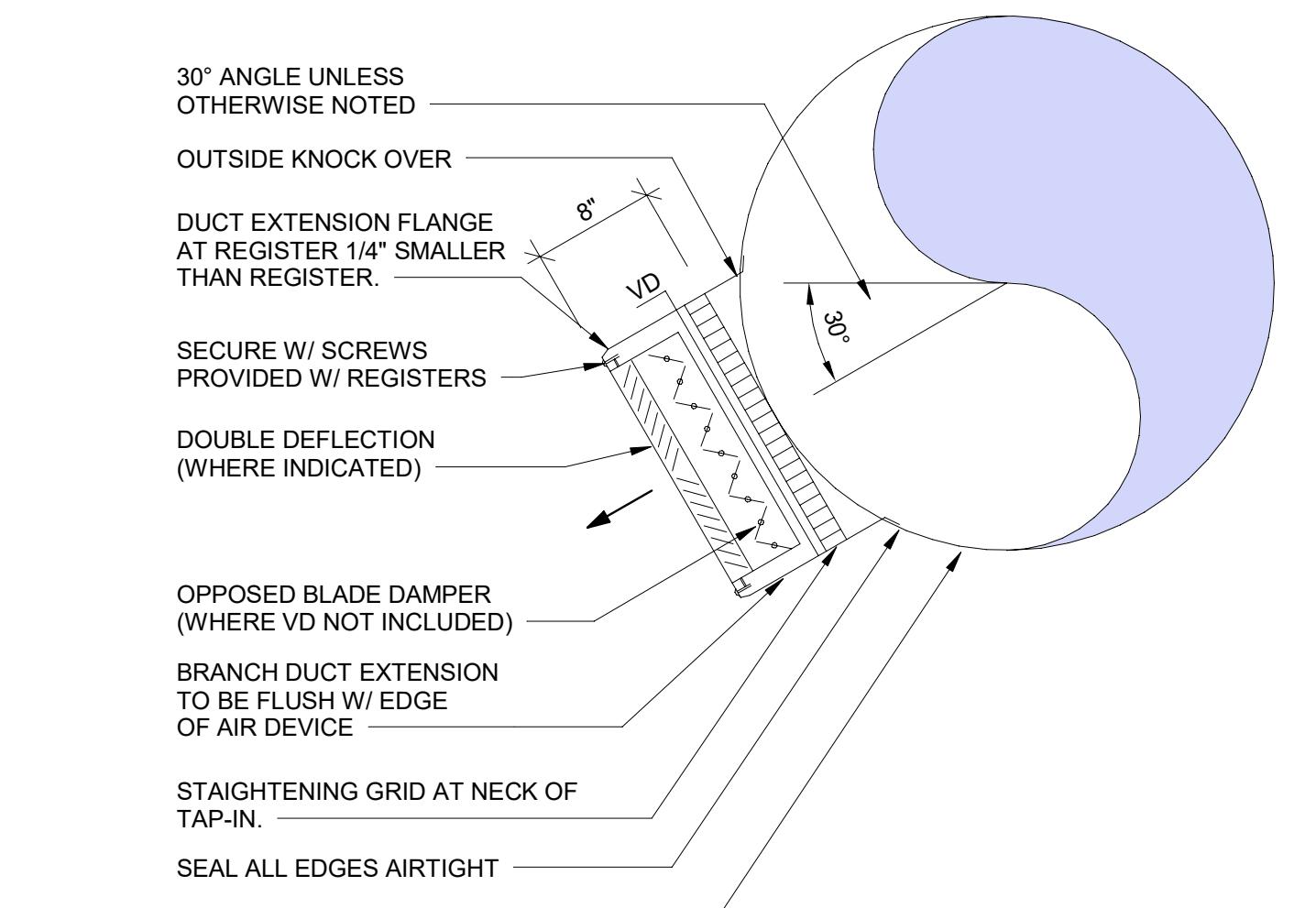
END OF SECTION 26 36 00



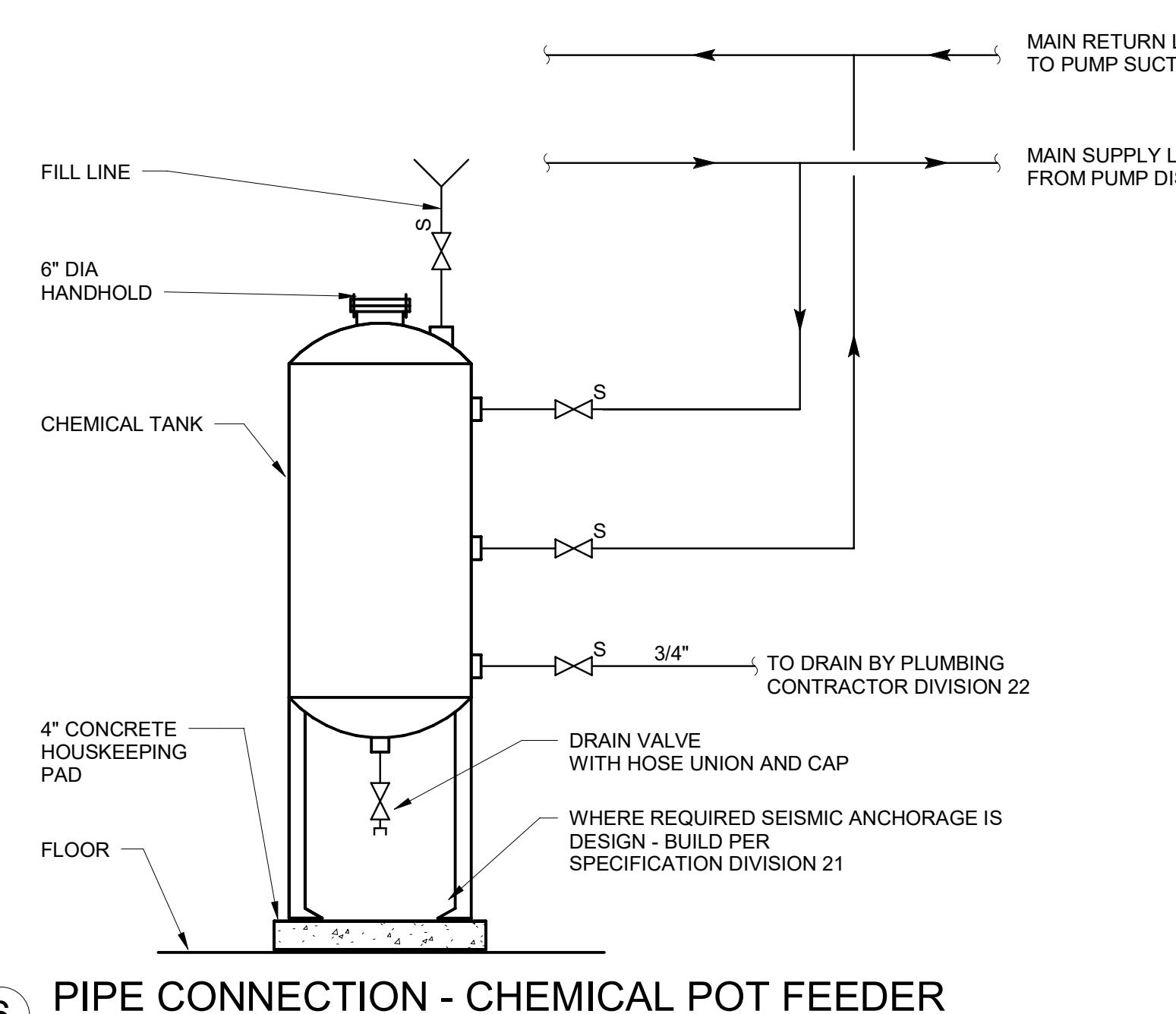
③ DUCT TERMINATION - LINEAR DIFFUSER
NTS



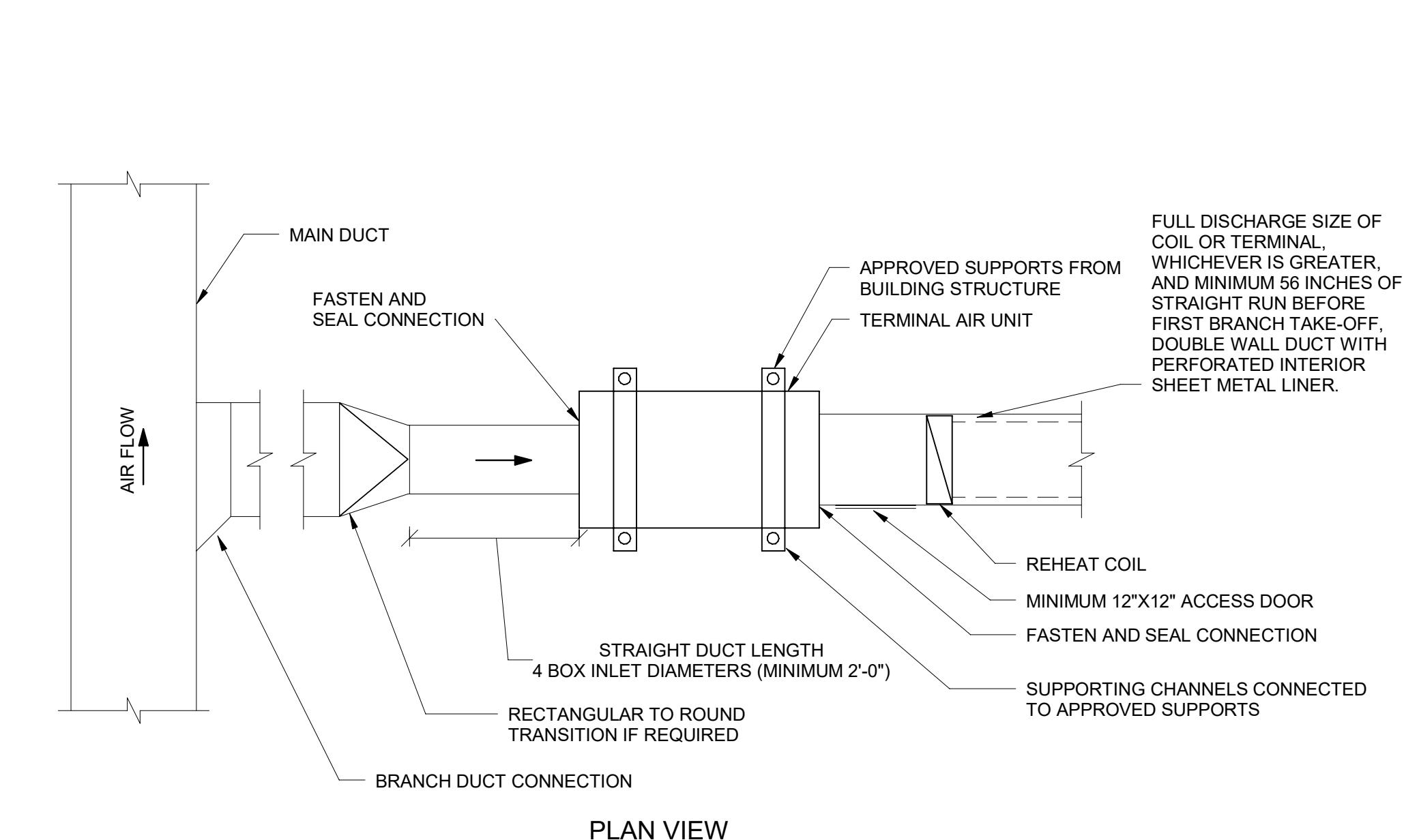
② DUCT CONNECTION - TERMINAL AIR UNIT
NTS



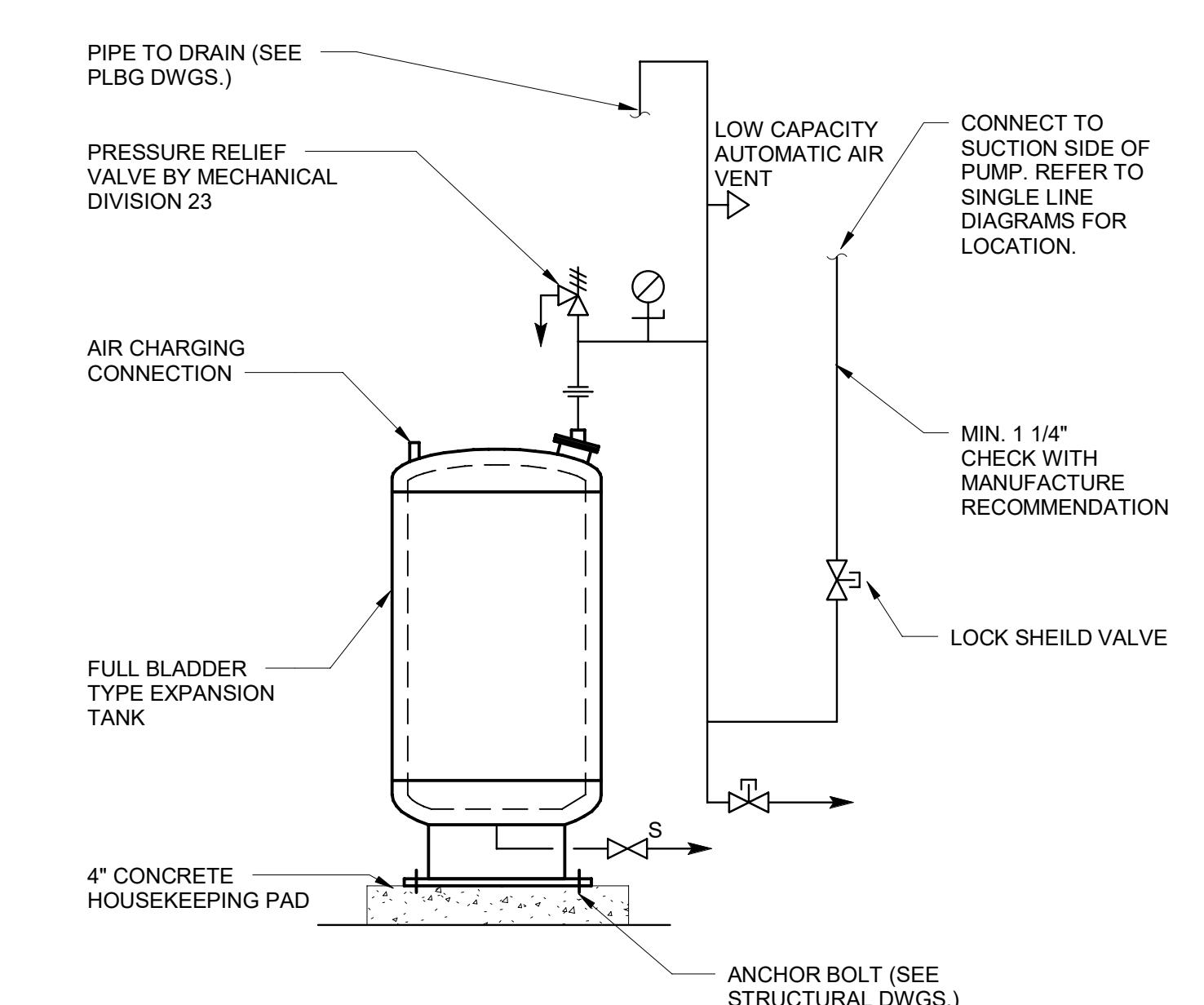
① DUCT TERMINATION - EXPOSED DIFFUSER
NTS



⑥ PIPE CONNECTION - CHEMICAL POT FEEDER
NTS



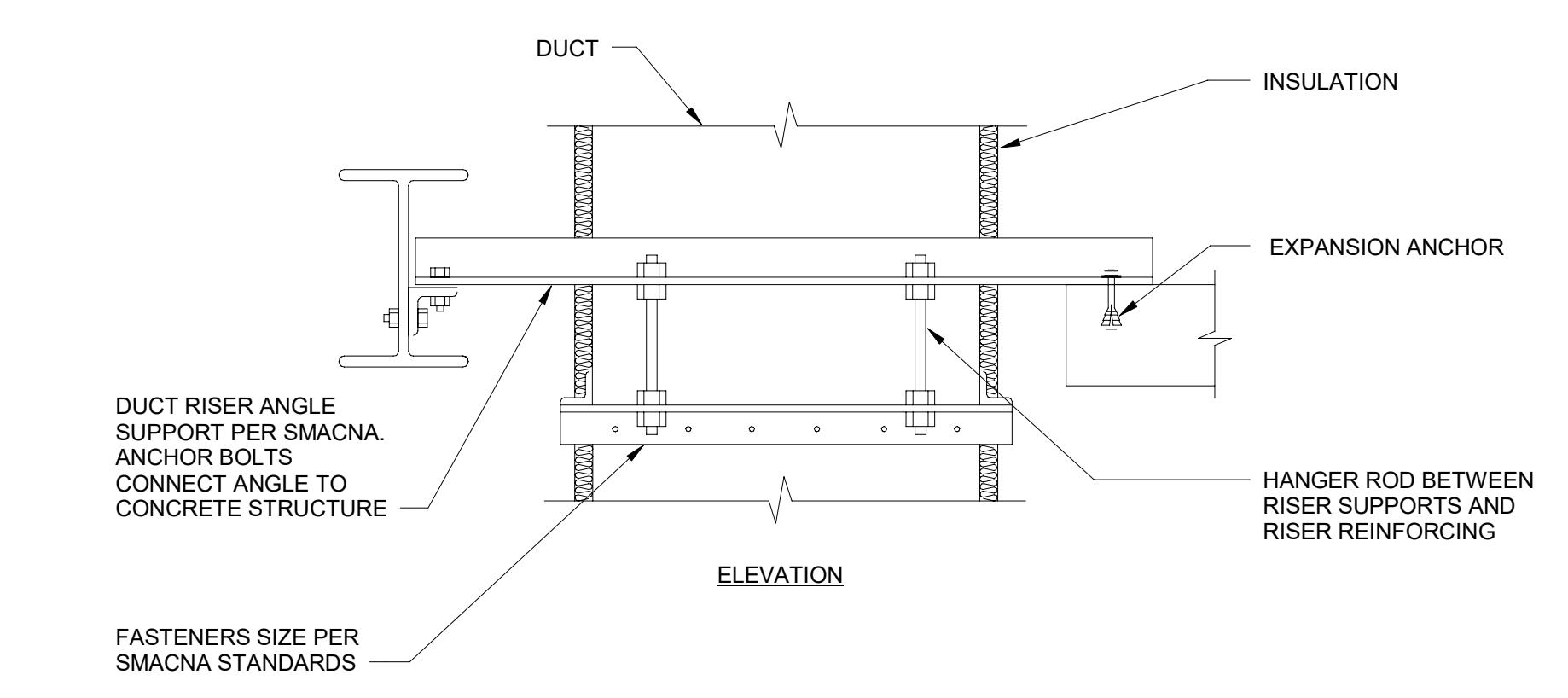
⑤ DUCT CONNECTION - TERMINAL AIR UNIT WITH REHEAT COIL
NTS



④ PIPE CONNECTION - EXPANSION TANK - VERTICAL
NTS



⑧ DUCT TERMINATION - CEILING DIFFUSER
NTS



⑦ DUCT INSTALLATION - RISER SUPPORT
NTS

CONSTRUCTION DOCUMENTS 12/19/25
WORCESTER SOUTH DIVISION FIRE STATION PROJECT
25 MADISON ST
WORCESTER, MA 01608



CITY OF WORCESTER
455 MAIN STREET
WORCESTER, MA 01605
KEY PLAN

ISSUE CHART

1 Addendum #5 1/16/26
1/15/2026 Job Number 157132.000
TITLE

MECHANICAL DETAILS

SHEET NUMBER

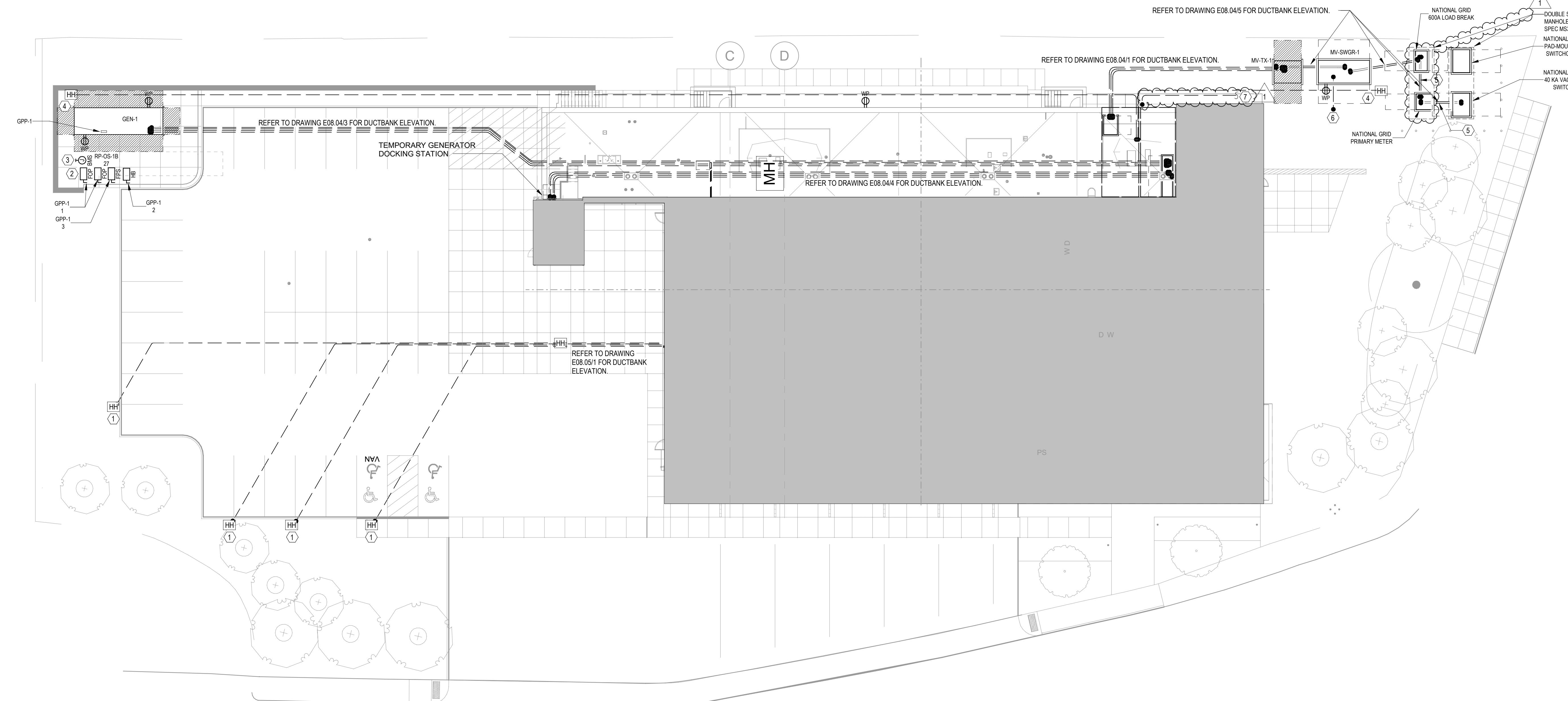
M08.02

KEY NOTES

- 1 CONDUIT AND WIRE SHALL BE FURNISHED AND ROUTED FROM PANEL PP-EV TO FUTURE EV CHARGER HANDHOLES.
- 2 FUEL OIL PUMPS, FUEL POLISHING SYSTEM, BMS AND HOTBOX SYSTEM SHALL BE LOCATED INSIDE FUEL PUMP ENCLOSURE PROVIDED BY DIVISION 2.
- 3 POWER CONNECTION FOR BMS PANEL COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR. BMS POWER LOCATED INSIDE FUEL PUMP ENCLOSURE.
- 4 FURNISH AND INSTALL HANDHOLE FOR DUCTBANK ELEVATION PROVIDED 1" EMPTY CONDUIT WITH PULLSTRING FROM HANDHOLE TO PANEL LP-1A.
- 5 FURNISH AND INSTALL (2) 4" EMPTY CONDUIT WITH PULLSTRING BETWEEN NATIONAL GRID EQUIPMENT.
- 6 PROVIDE SPARE CONDUIT FROM SWITCHGEAR AND STUB OUT UNDERGROUND 5 FEET BEYOND CONCRETE PAD FOR FUTURE USE. CONDUIT SHALL BE CAPPED AND SEALED UNDERGROUND.
- 7 FURNISH AND INSTALL CONDUIT UNDERGROUND FROM FUTURE RTU LOCATION TO SITE PROPERTY LINE FOR RTU MONITORING TELEPHONE LINE. COORDINATE ALL REQUIREMENTS WITH NATIONAL GRID.

GENERAL NOTES

1. SEE DRAWING E00.00 FOR LEGENDS, NOTES, AND ABBREVIATIONS.
2. UNROUTED CONDUIT ROUTING IS DIAGRAMMATIC AND INTENDED TO CONVEY CONNECTIVITY RATHER THAN ACTUAL CONDUIT ROUTINGS. CONDUIT RUNS, WHERE SHOWN, ARE INTENDED TO REPRESENT GENERAL CONDUIT ROUTING. IT IS THE CONTRACTOR'S RESPONSIBILITY FOR DETERMINING THE EXACT QUANTITY, CONFIGURATION AND ROUTING IN THE FIELD. NOT ALL CONDUIT RUNS ARE SHOWN.



1 ELECTRICAL SITE PLAN
1/16" = 1'-0"

PROJECT
WORCESTER SOUTHERN DIVISION FIRE STATION PROJECT
25 MADISON ST
WORCESTER, MA 01608



CITY OF WORCESTER
455 MAIN STREET
WORCESTER, MA 01605

KEY PLAN



1 Addendum #5
1/16/26
Job Number 157132.000
TITLE

ELECTRICAL SITE POWER PLAN

SHEET NUMBER

E01.01

KEY NOTES

- 1 PROVIDE (5) 4" CONDUIT WITH PULLSTRING FOR FUTURE APPARATUS BAY EV CHARGERS. STUB UP AND CAP OFF FOR FUTURE USE. REFER TO SHEET E08.01 FOR CONTINUED CONDUIT ROUTING.
- 2 PROVIDE (1) 4" CONDUIT WITH PULLSTRING FOR FUTURE ROOFTOP PV SYSTEM. STUB UP AND CAP OFF FOR FUTURE USE. REFER TO DWGS E08.02, E08.03 AND E08.03 FOR CONTINUED CONDUIT ROUTING.
- 3 GROUND BAR SHALL EXTEND ACROSS THE ENTIRE LENGTH OF THE WALL.
- 4 TRANSFORMER SHALL BE CEILING MOUNTED. REFER TO DETAILS 1 AND 3 ON DRAWING E08.01 FOR TRANSFORMER MOUNTING AND SUPPORT REQUIREMENTS.
- 5 TF-EV SECONDARY OCPD.
- 6 FURNISH AND INSTALL A 400A CT CABINET AND 400A, 480V DISCONNECT IN NEMA 3R ENCLOSURE FOR PV SYSTEM DISCONNECT, PER NATIONAL GRID REQUIREMENTS. BOTTOM OF CIRCUIT BREAKER SHALL BE 30" ABOVE GROUND. ENCLOSURE SHALL BE 4 FEET ABOVE GRADE.
- 7 NATIONAL GRID DISTRIBUTED GENERATION STUDY TO DETERMINE IF TELEMETRY REMOTE TERMINAL UNIT (RTU) WILL BE REQUIRED. PROVIDED SPACE FOR INSTALLATION OF FUTURE TELEMETRY EQUIPMENT ENCLOSURES. RTU DIMENSIONS ARE 42" X 30" W X 12" D. RTU SHALL BE MOUNTED MINIMUM 36" ABOVE GRADE AND ALL CONDUITS ENTERING THE RTU ENCLOSURE SHALL PROVIDE JUNCTION BOX WITH DEDICATED 120V/20A CIRCUIT FOR RTU. RTU ENCLOSURE SHALL BE NEMA 4X. COORDINATE ALL RTU AND TELEPHONE REQUIREMENTS WITH NATIONAL GRID AND THE TELEPHONE UTILITY.
- 8 RTU TELEPHONE EQUIPMENT ENCLOSURE SHALL BE NEMA 4X AND SHALL BE SIZED TO ACCOMMODATE A 48" X 48" W X 3/4" D PLYWOOD PANEL FOR MOUNTING OF TELEPHONE EQUIPMENT. PROVIDE JUNCTION BOX WITH DEDICATED 120V/20A CIRCUIT. COORDINATE ALL REQUIREMENTS FOR RTU TELEPHONE EQUIPMENT WITH NATIONAL GRID AND THE TELEPHONE UTILITY.



1 LEVEL 1 MAIN NORMAL AND EM ELECTRICAL ROOMS - COORDINATION PLAN
 1/4" = 1'-0"

2 LEVEL 1 MAIN NORMAL AND EM ELECTRICAL ROOMS - POWER PLAN
 1/4" = 1'-0"

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KEY PLAN

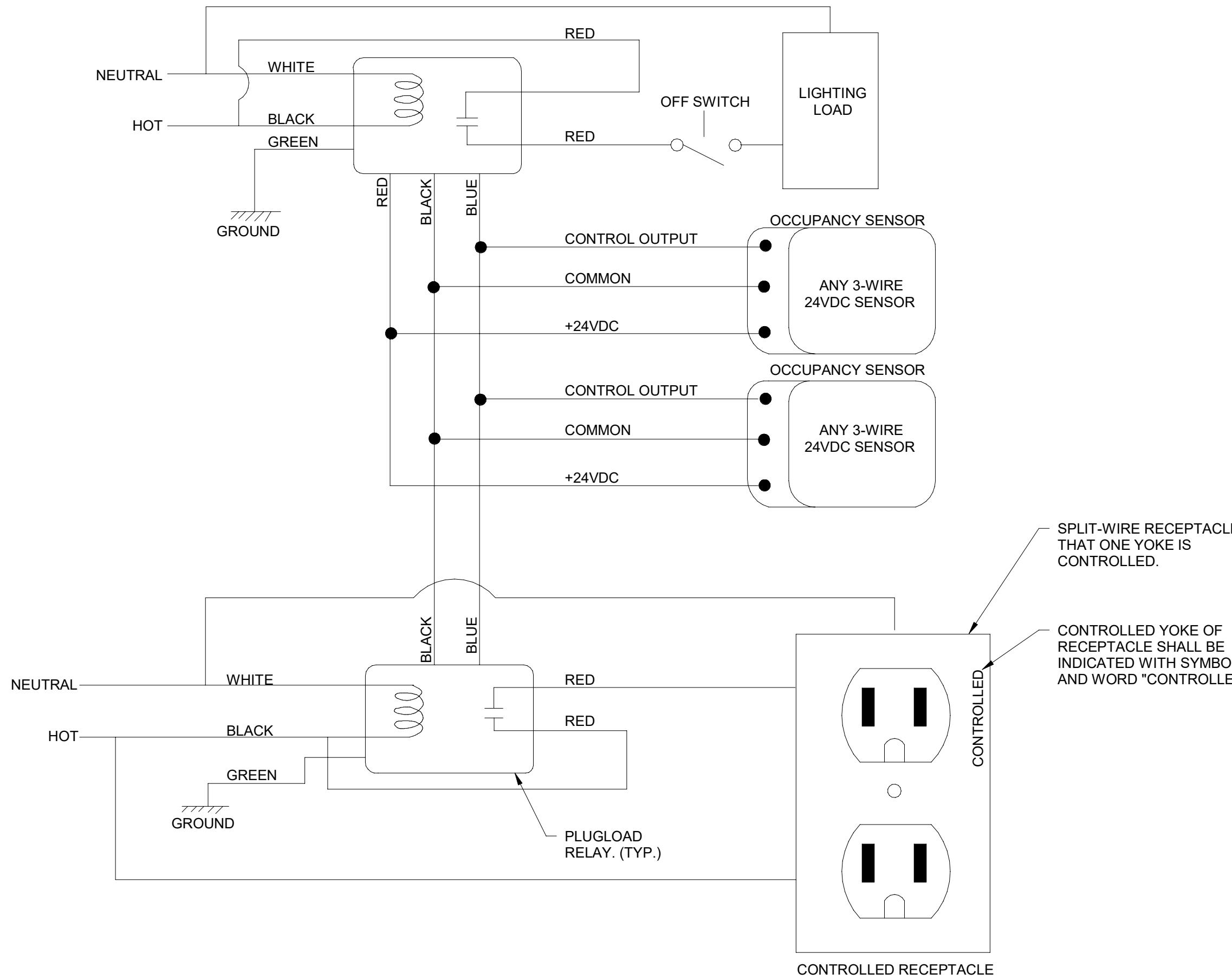


ISSUE CHART

1 Addendum #5
 MARK ISSUE DATE
 Job Number 15732.000
 TITLE

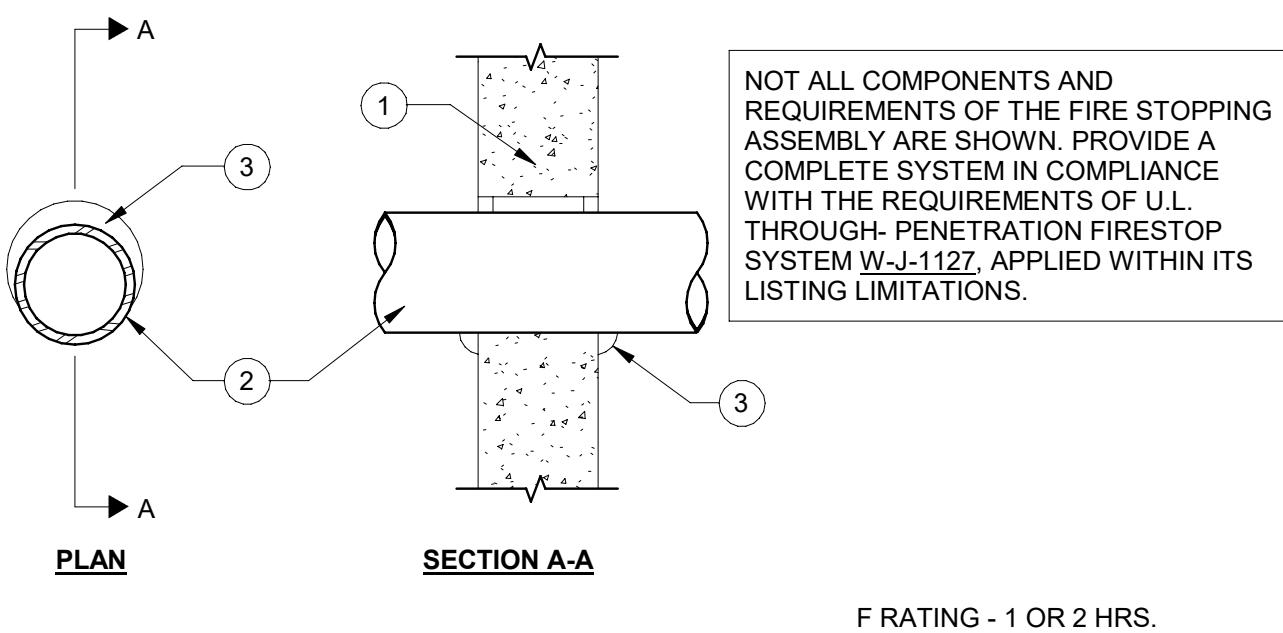
ELECTRICAL PART PLANS
 SHEET NUMBER

E07.00



① TYPICAL CONTROLLED RECEPTACLE

NTS

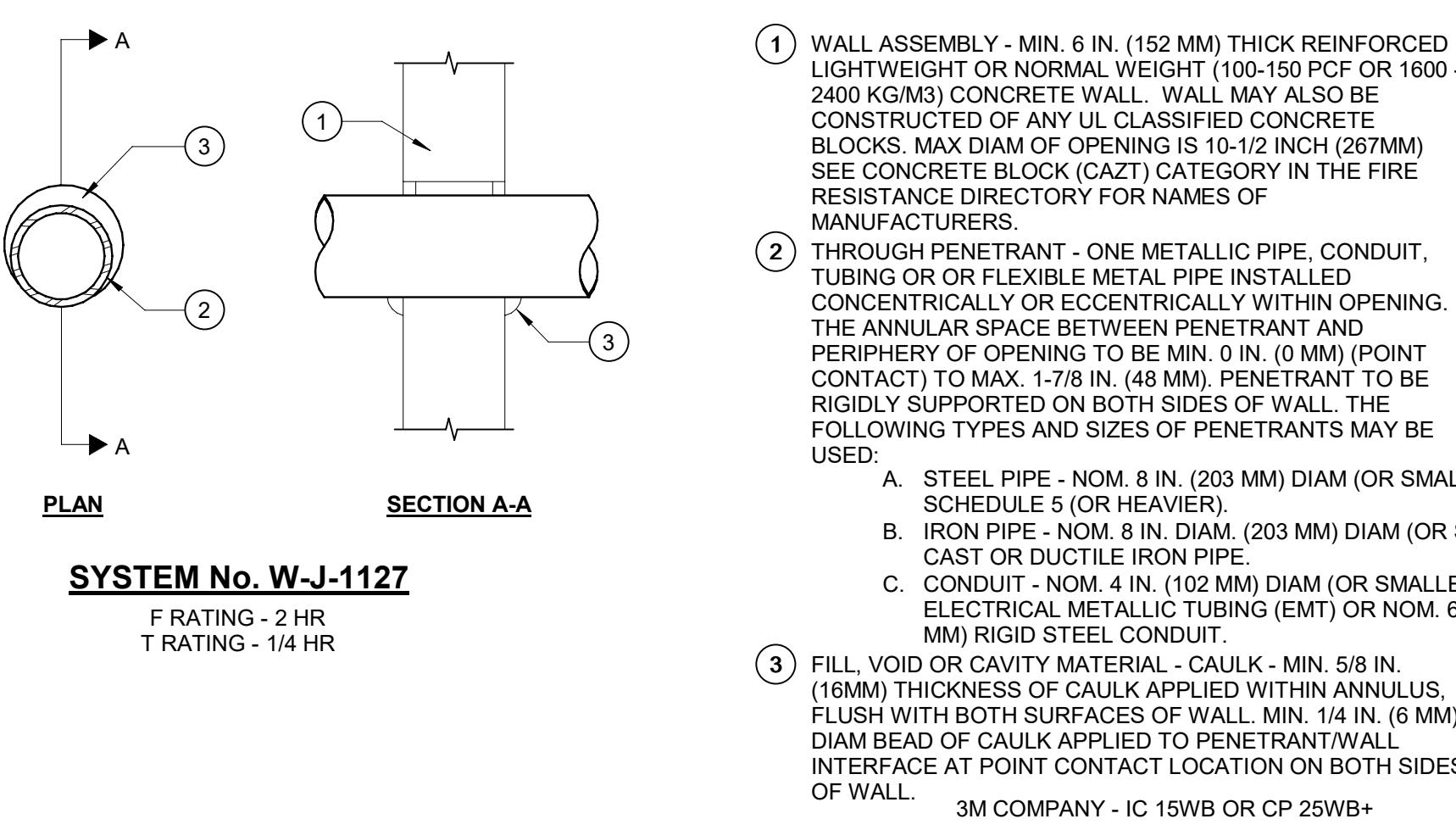


NOTES:

- WALL ASSEMBLY - MIN. 6 IN. THICK REINFORCED LIGHTWEIGHT OR NORMAL WEIGHT CONCRETE WALL. WALL MAY ALSO BE CONSTRUCTED OF ANY CONCRETE BLOCKS. MAX. DIAM. OF OPENING IS 10-1/2 INCH
- THROUGH PENETRANT - ONE METALLIC CONDUIT, (MAX. 4" EMT OR RSC) INSTALLED CONCENTRICALLY OR ECCENTRICALLY WITHIN OPENING. THE ANNULAR SPACE BETWEEN PENETRANT AND PERIPHERY OF OPENING TO BE MIN. 0 IN. TO MAX. 1-7/8 IN.
- FILL, VOID OR CAVITY MATERIAL - CAULK - MIN. 5/8 IN. THICKNESS OF CAULK APPLIED WITHIN ANNULUS, FLUSH WITH BOTH SURFACES OF WALL. MAX. 1/4 IN. (6 MM) DIAM. BEAD OF CAULK APPLIED TO PENETRANT/WALL INTERFACE AT POINT CONTACT LOCATION ON BOTH SIDES OF WALL. 3M COMPANY - IC 15WB OR CP 25WB+

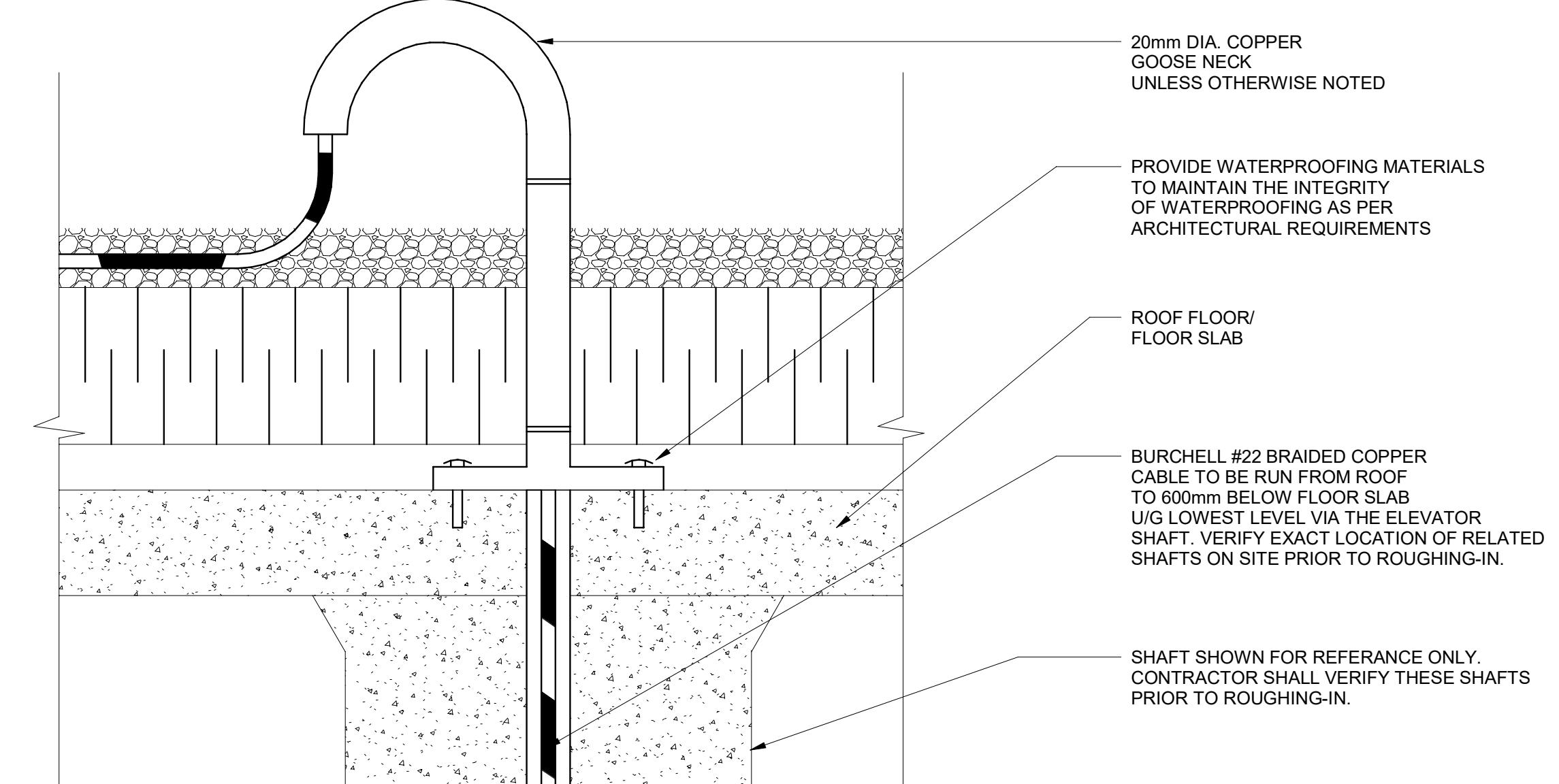
② CONDUIT FIREWALL PENETRATION

NTS



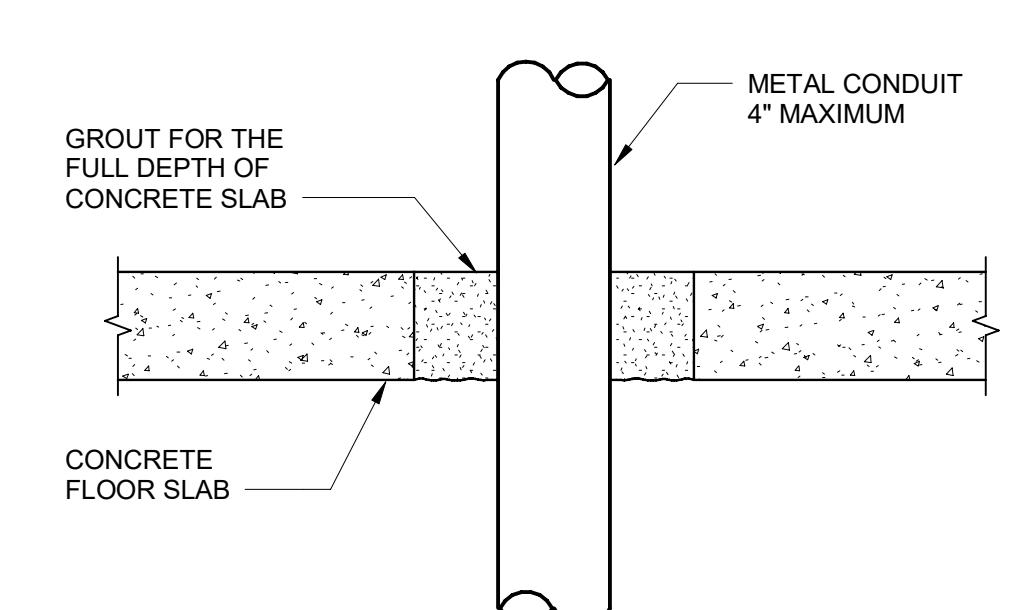
③ MODULAR WIRING DETAIL

NTS



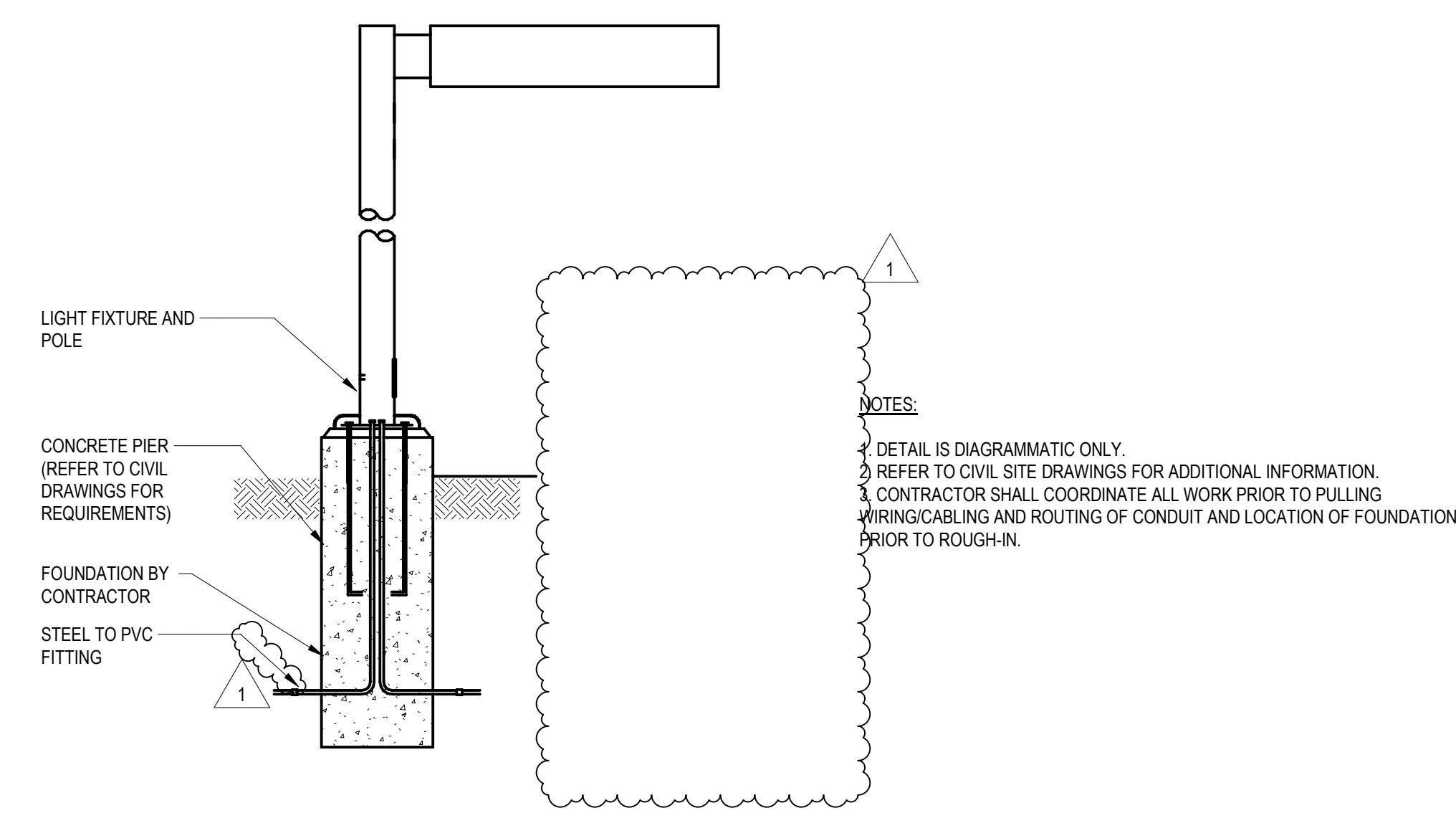
④ TYPICAL ROOF PENETRATION DETAIL

NTS



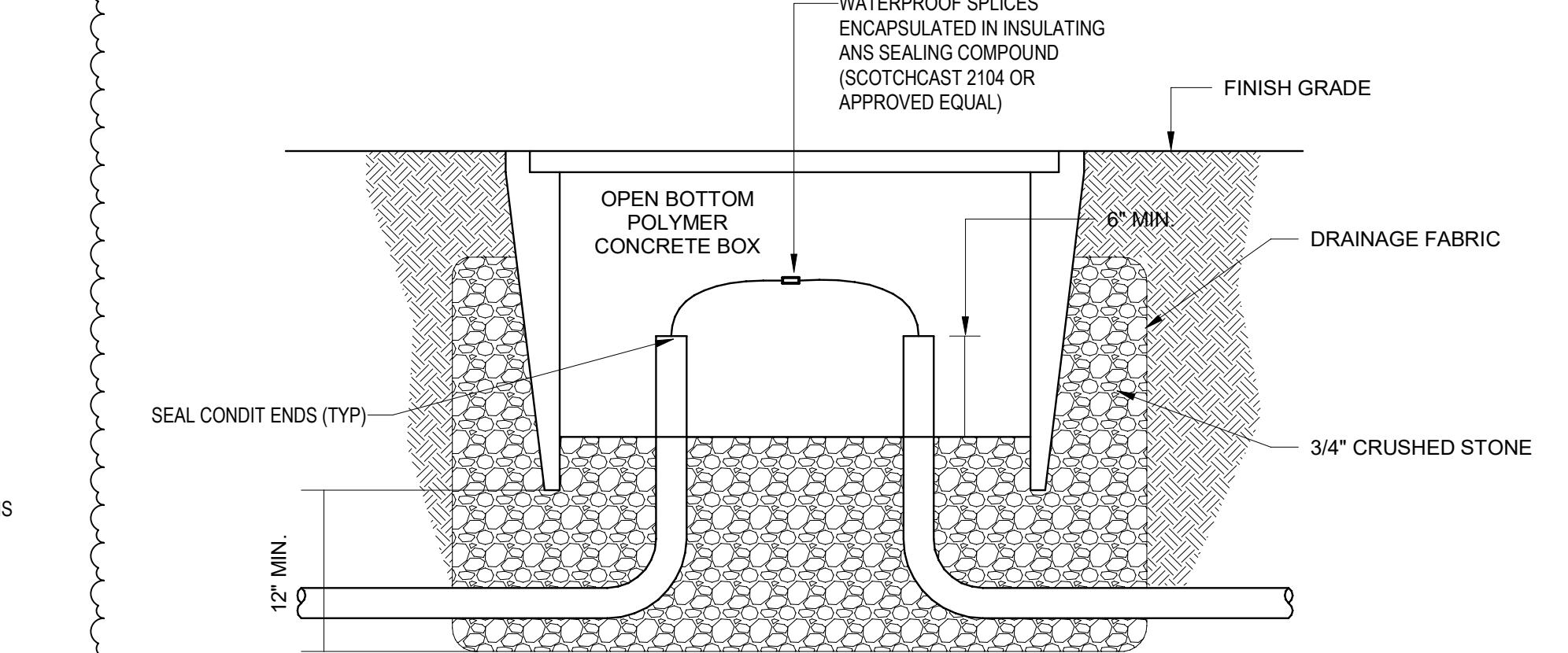
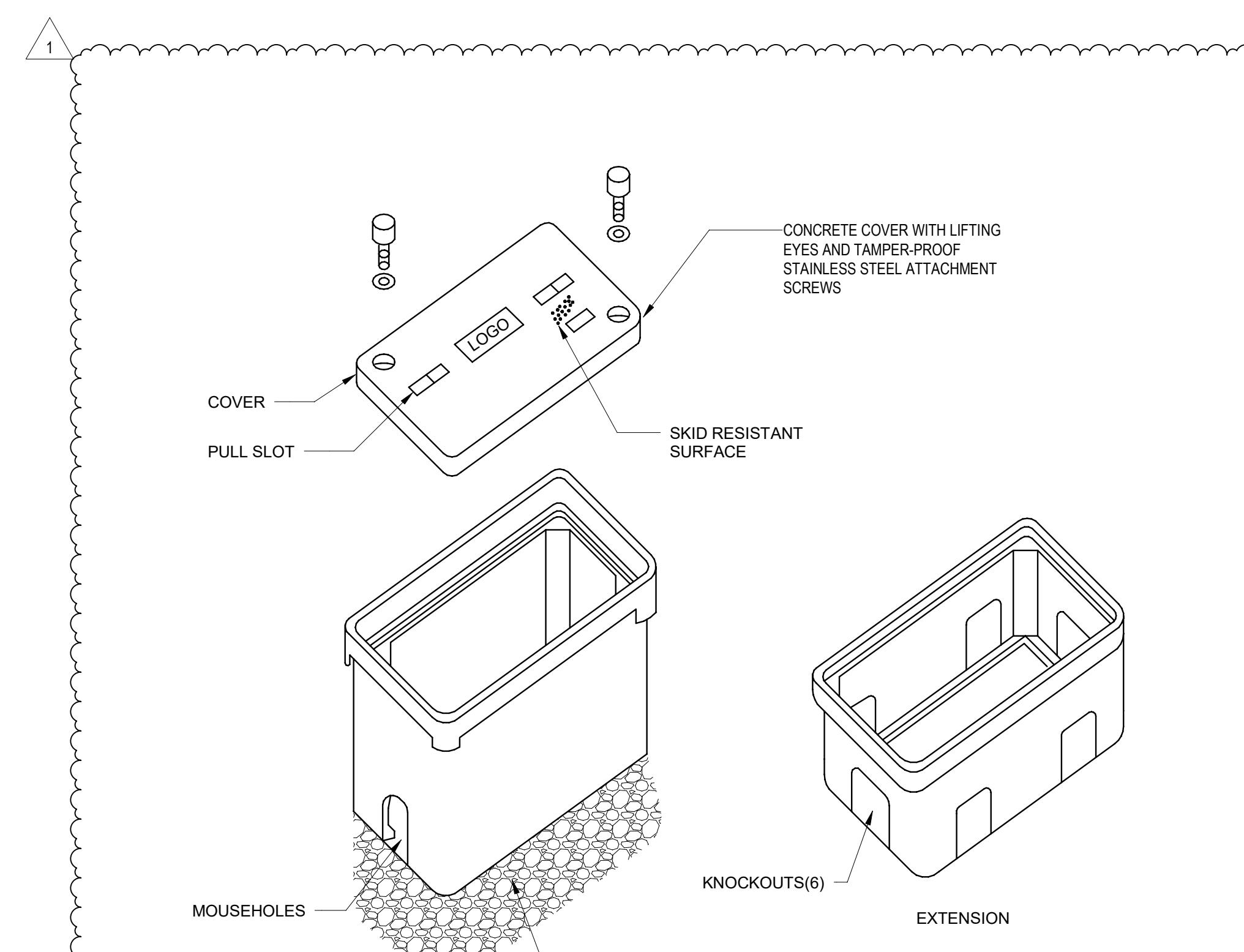
⑤ CONDUIT FLOOR PENETRATION

NTS



⑥ LIGHT POLE MOUNTING DETAIL

NTS



⑦ ELECTRICAL HANDHOLE INSTALLATION DETAIL

NTS

 PROJECT
 WORCESTER SOUTH DIVISION FIRE STATION PROJECT
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 WORCESTER, MA 01608

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 455 MAIN STREET
 WORCESTER, MA 01605

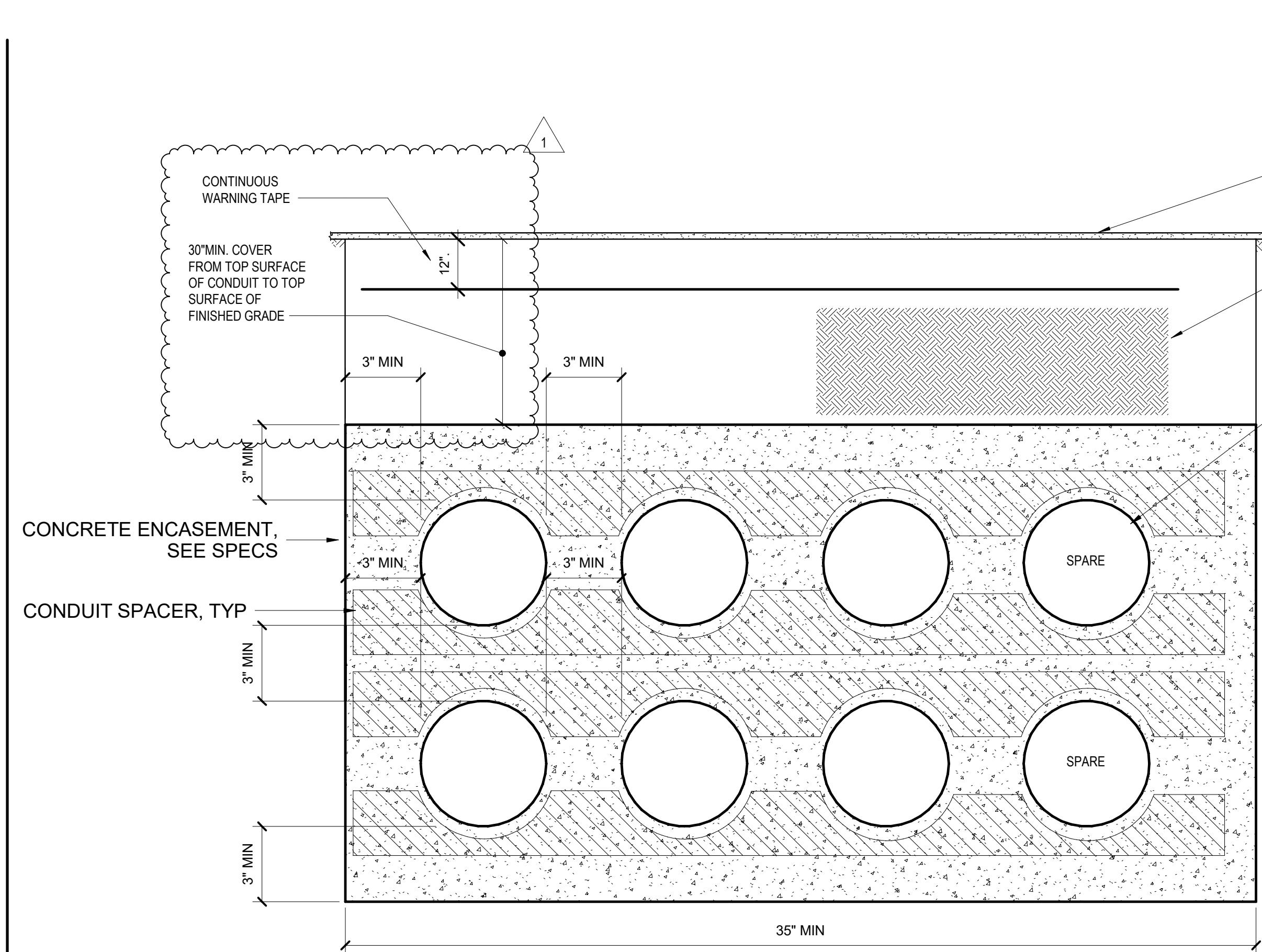
KEY PLAN

ISSUE CHART

 1 Addendum #5 1/16/26
 Job Number 15732.000
 TITLE

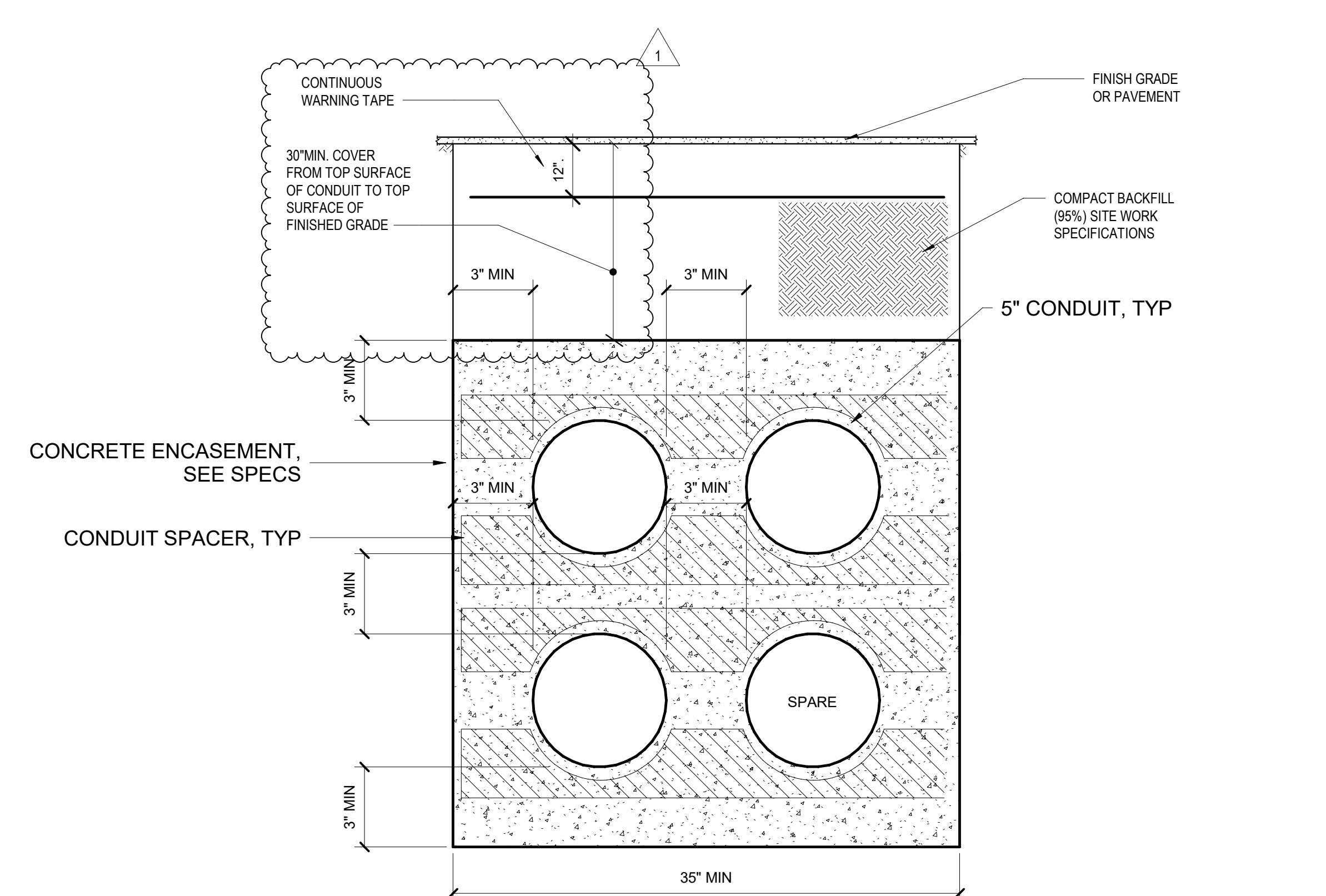
 ELECTRICAL DETAILS SHEET 3
 SHEET NUMBER

E08.03



NOTE: DUCT BANK DETAIL FOR REFERENCE ONLY. COORDINATE DUCT BANK WITH CIVIL.

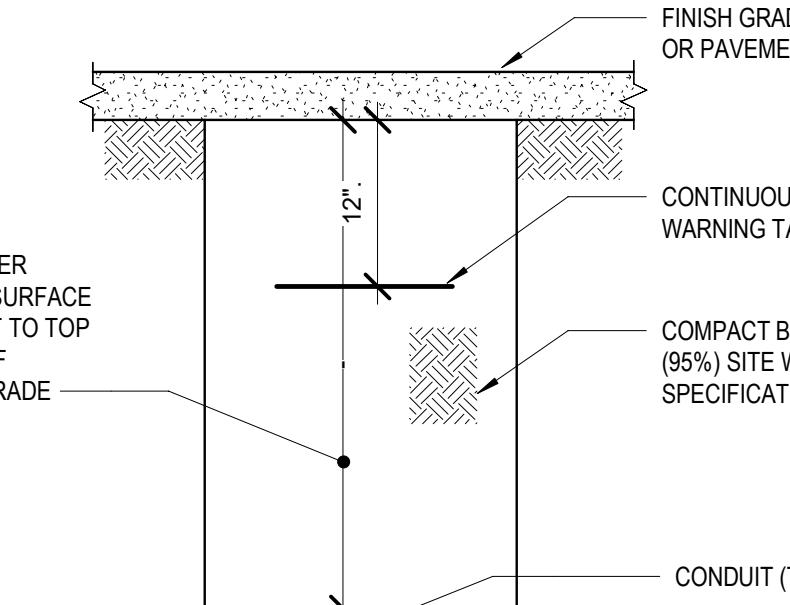
1 MAIN SWITCHBOARD DUCT BANK
NTS



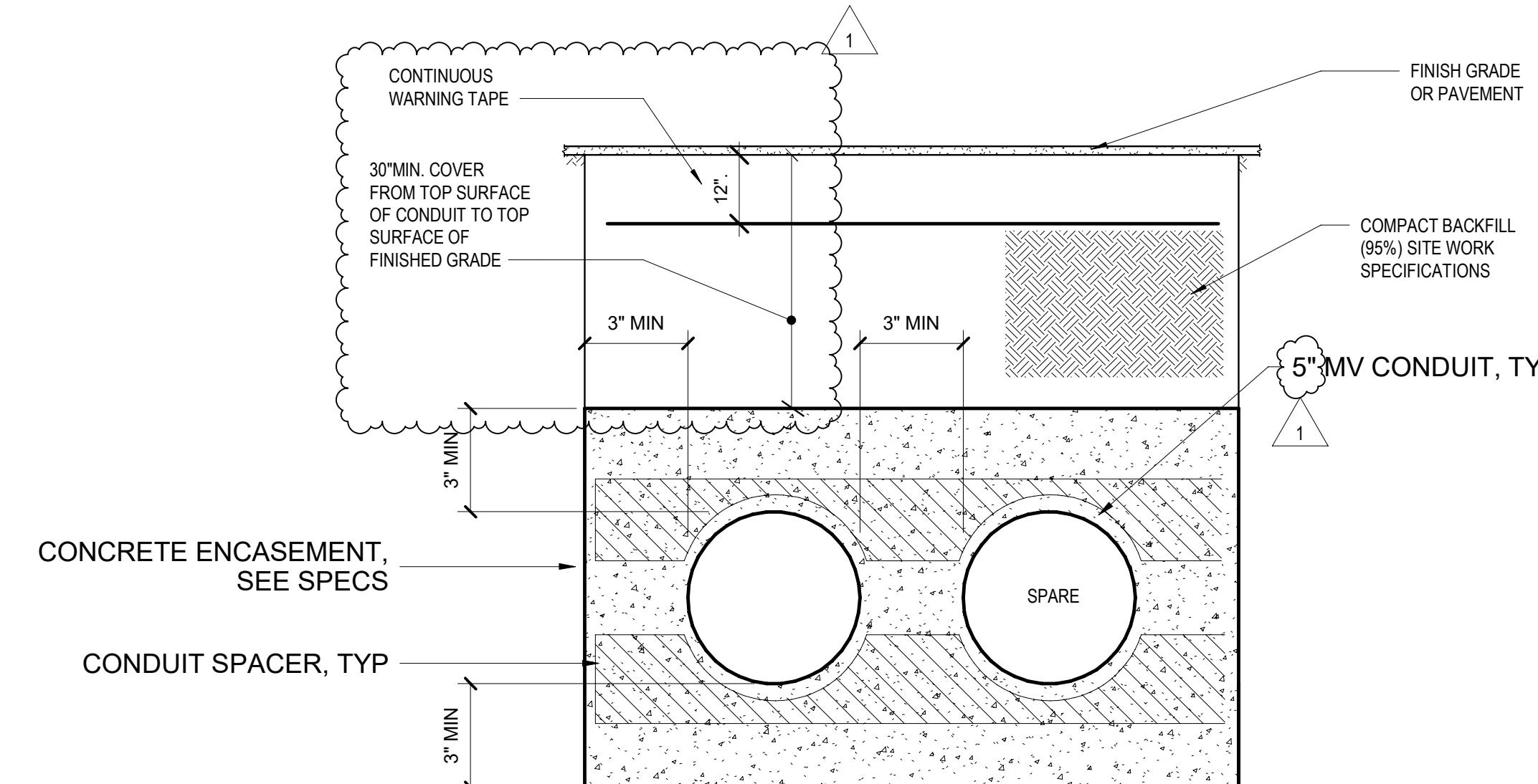
NOTE: DUCT BANK DETAIL FOR REFERENCE ONLY. COORDINATE DUCT BANK WITH CIVIL.

4 TEMP GENERATOR DOCKING STATION DUCT BANK
NTS

1 MAIN SWITCHBOARD DUCT BANK
NTS

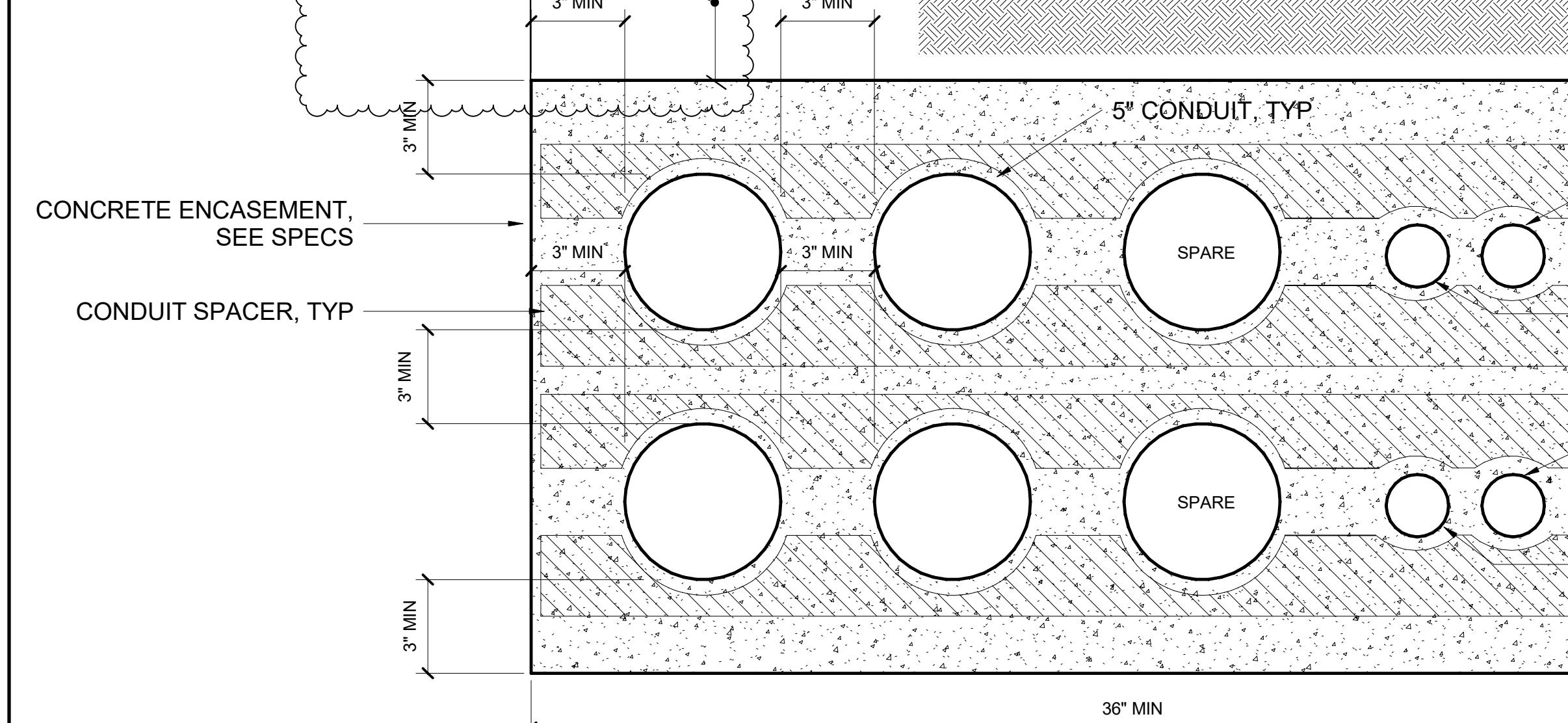


2 DIRECT BURIAL CONDUIT
NTS



NOTE: DUCT BANK DETAIL FOR REFERENCE ONLY. COORDINATE DUCT BANK WITH CIVIL.

5 MV DUCT BANK
NTS



NOTE:
1. DUCT BANK DETAIL FOR REFERENCE ONLY. COORDINATE DUCT BANK WITH CIVIL.

3 GENERATOR DUCT BANK
NTS



PROJECT
WORCESTER SOUTH DIVISION FIRE STATION PROJECT
25 MADISON ST
WORCESTER, MA 01608



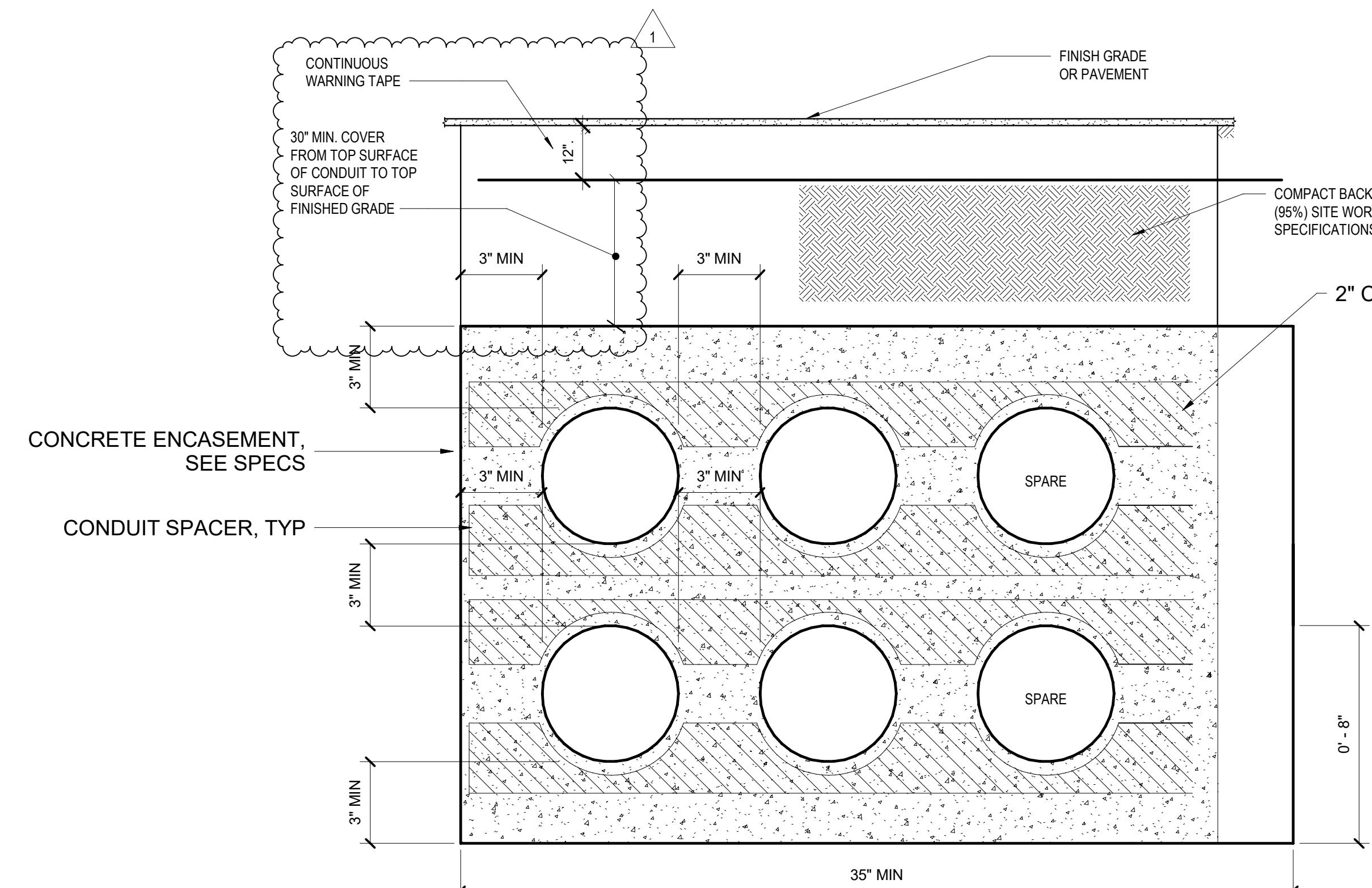
CONSTRUCTION DOCUMENTS 12/19/25
CITY OF WORCESTER
455 MAIN STREET
WORCESTER, MA 01605
KEY PLAN



1 Addendum #5 1/16/26
Job Number 15732.000
TITLE

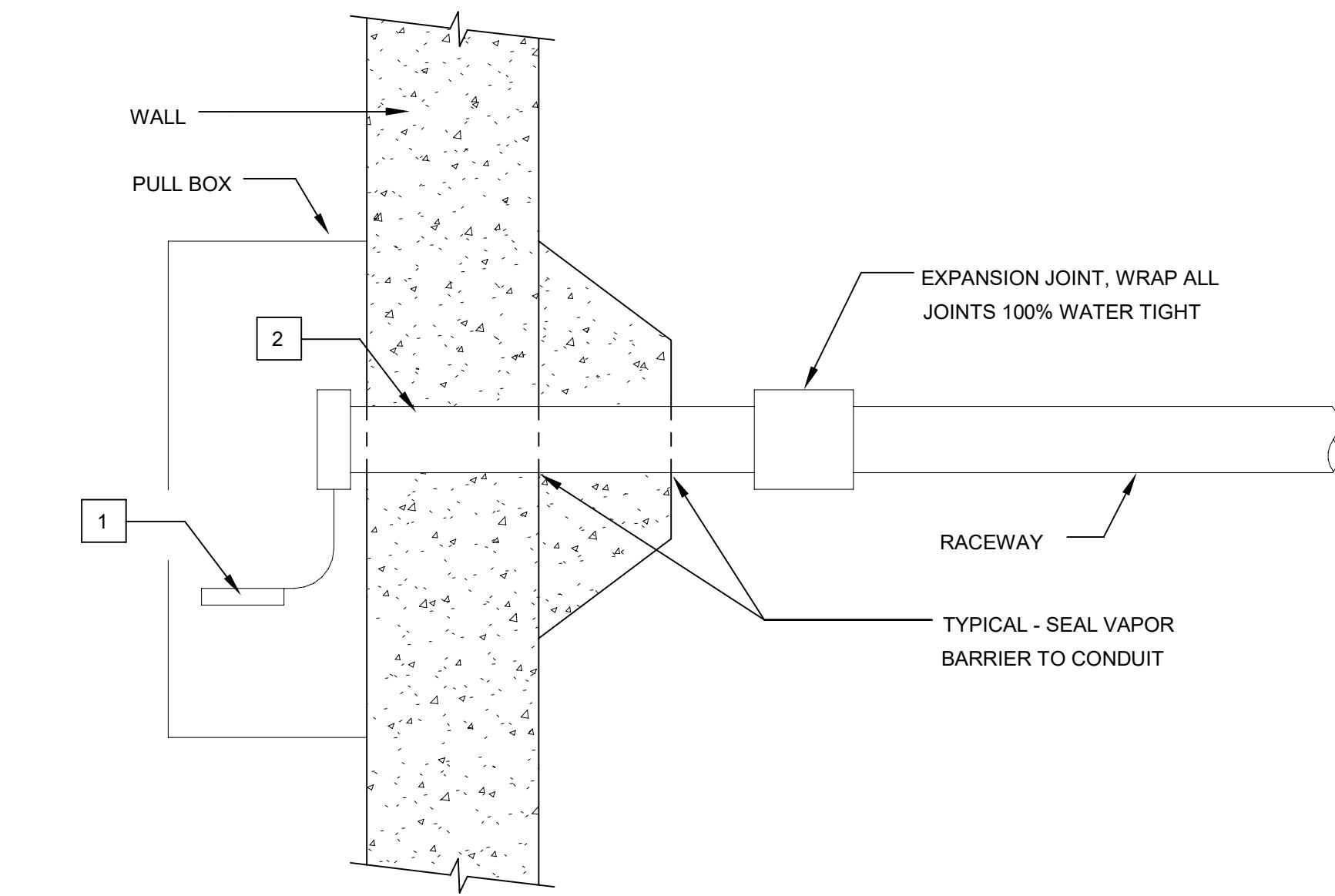
ELECTRICAL DETAILS SHEET 4
SHEET NUMBER

E08.04



NOTE: DUCT BANK DETAIL FOR REFERENCE ONLY. COORDINATE DUCT BANK WITH CIVIL.

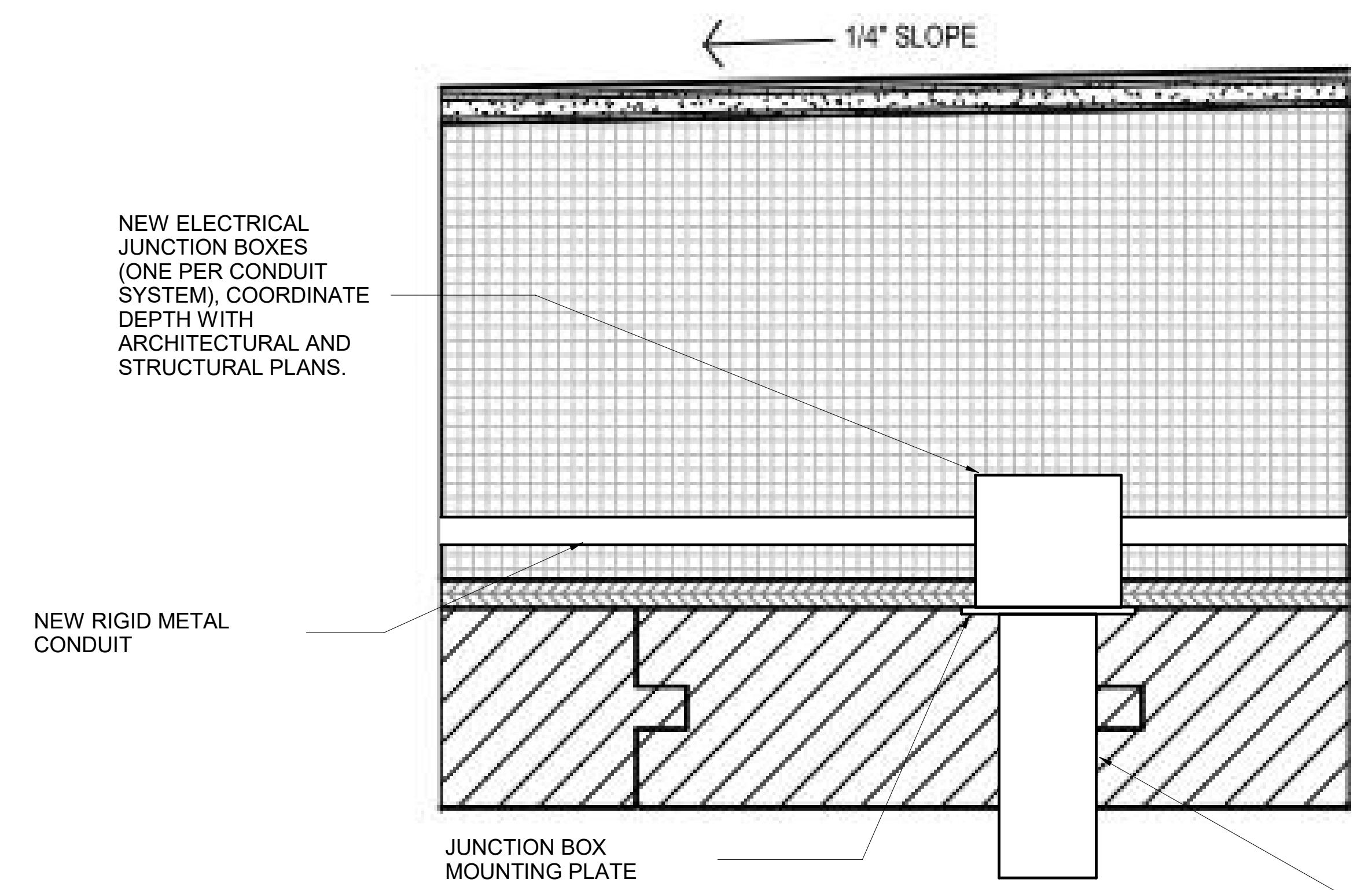
① EV CHARGING DUCT BANK
NTS



KEYED NOTES:

- ① AT EACH CONDUIT, PROVIDE AN ENGRAVED PLASTIC NAMEPLATE, INDICATING CONDUIT NO., AND ATTACH TO CONDUIT WITH NYLON CABLE TIE.
- ② PROVIDE CONDUIT SLEEVE AND "LINK SEAL" FOR ALL PENETRATIONS BELOW GRADE.

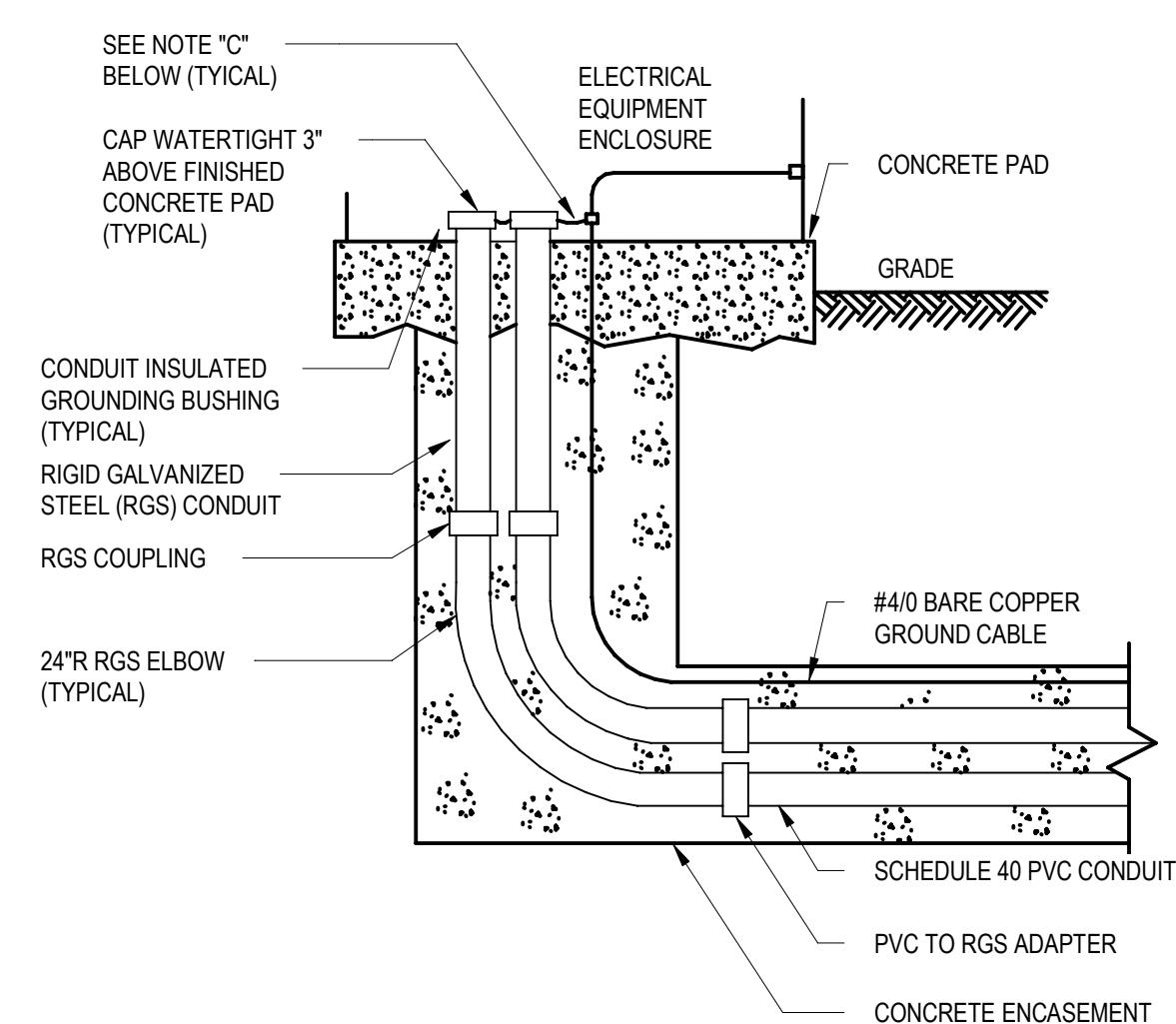
③ DIRECT BURIAL CONDUIT PENETRATION INTO BUILDING
NTS



② KITCHEN / DAYROOM CONDUIT ROUTING
NTS

NOTE:

1. ALL CONDUIT IN THE DAYROOM AND KITCHEN SHALL BE CONCEALED. OVERHEAD CONDUITS SHALL BE ROUTED OVERHEAD WITHIN THE CEILING.
2. PROVIDE RIGID METAL CONDUIT FOR ALL WIRING REQUIRED TO BE ROUTED WITHIN 1-1/2" OF ROOF DECKING PER NEC 300.4(E).



NOTE C:
ALL RIGID GALVANIZED STEEL CONDUIT SHALL HAVE AN INSULATED GROUNDING BUSHING INSTALLED. ALL INSULATED GROUNDING BUSHINGS SHALL BE CONNECTED WITH #4/0 BARE COPPER GROUND CABLE TO THE #4/0 BARE COPPER GROUND CABLE RUN WITH THE DUCTBANK.

④ TYPICAL CONDUIT STUB-UP DETAIL
NTS

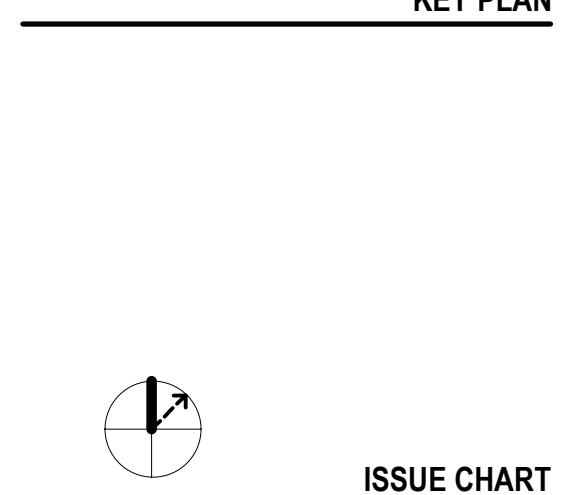
CONSTRUCTION DOCUMENTS 12/19/25
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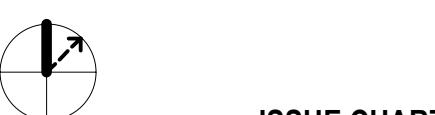
KEY PLAN



1 Addendum #5
1/16/26
Job Number 157132.000
TITLE

ELECTRICAL DETAILS SHEET 5
SHEET NUMBER

E08.05

WORCESTER SOUTH
DIVISION FIRE
STATION PROJECT25 MADISON ST
WORCESTER, MA 01608CITY OF WORCESTER
455 MAIN STREET
WORCESTER, MA 01605
KEY PLANELECTRICAL PANEL
SCHEDULES SHEET 1

LOCATION: EMERGENCY ELEC 111											
SUPPLY FROM: ATS-OS-1A											
MOUNTING: SURFACE											
ENCLOSURE: Type 1											
1	ASHP-1 - EXTERIOR	HVAC	1	110 A	3	11584...	12714...	3	60 A	1	HVAC DOAS-1 - ROOF
3	-	-	-	-	-	11584...	12714...	-	-	-	-
7	ASHP-1 - EXTERIOR	HVAC	1	110 A	3	11584...	18000...	3	100 A	1	HVAC WH-2 - RM 114
9	-	-	-	-	-	11584...	18000...	-	-	-	-
11	-	-	-	-	-	11584...	18000...	-	-	-	-
13	VRF-1 - EXTERIOR	HVAC	1	30 A	3	3520...	53999...	3	300 A	1	HVAC TF-OS-1A
15	-	-	-	-	-	3520...	54818...	-	-	-	-
17	-	-	-	-	-	3520...	54892...	-	-	-	-
19	VRF-2 - EXTERIOR	HVAC	1	50 A	3	4960...	4062...	3	100 A	1	LIGH... LP-1A
21	-	-	-	-	-	4960...	2679...	-	-	-	-
23	-	-	-	-	-	4960...	2917...	-	-	-	-
25	EUH-4 - APPARATUS BAY	HVAC	1	20 A	3	3324...	0 VA	3	110 A	-	SPARE
27	-	-	-	-	-	3324...	0 VA	-	-	-	-
29	-	-	-	-	-	3324...	0 VA	-	-	-	-
31	EUH-5 - APPARATUS BAY	HVAC	1	20 A	3	3324...	0 VA	3	20 A	-	SPARE
33	-	-	-	-	-	3324...	0 VA	-	-	-	-
35	-	-	-	-	-	3324...	0 VA	-	-	-	-
37	SPARE	-	-	20 A	3	0 VA	0 VA	3	20 A	-	SPARE
39	-	-	-	-	-	0 VA	0 VA	-	-	-	-
41	-	-	-	-	-	0 VA	0 VA	-	-	-	-
TOTAL LOAD: 127050 VA											
TOTAL AMPS: 459 A											
LOAD CLASSIFICATION											
CONNECTED LOAD											
DEMAND FACTOR											
ESTIMATED DEMAND											
PANEL TOTALS											
HVAC	21875 VA	100.00%	21875 VA								
LIGHTING (LTG)	10587 VA	125.00%	13233 VA								
Motor	3000 VA	100.00%	3000 VA								
POWER	73159 VA	100.00%	73159 VA								
RECEPTACLE (R)	74460 VA	56.72%	42230 VA								
Spare	360 VA	100.00%	360 VA								
NOTES:											

LOCATION: EMERGENCY ELEC 111											
SUPPLY FROM: PP-OS-1B											
MOUNTING: SURFACE											
ENCLOSURE: Type 1											
1	ASHP-1 - EXTERIOR	HVAC	1	110 A	3	11584...	12714...	3	60 A	1	HVAC DOAS-1 - ROOF
3	-	-	-	-	-	11584...	12714...	-	-	-	-
7	ASHP-1 - EXTERIOR	HVAC	1	110 A	3	11584...	18000...	3	100 A	1	HVAC WH-2 - RM 114
9	-	-	-	-	-	11584...	18000...	-	-	-	-
11	-	-	-	-	-	11584...	18000...	-	-	-	-
13	VRF-1 - EXTERIOR	HVAC	1	30 A	3	3520...	53999...	3	300 A	1	HVAC TF-OS-1A
15	-	-	-	-	-	3520...	54818...	-	-	-	-
17	-	-	-	-	-	3520...	54892...	-	-	-	-
19	VRF-2 - EXTERIOR	HVAC	1	50 A	3	4960...	4062...	3	100 A	1	LIGH... LP-1A
21	-	-	-	-	-	4960...	2679...	-	-	-	-
23	-	-	-	-	-	4960...	2917...	-	-	-	-
25	EUH-4 - APPARATUS BAY	HVAC	1	20 A	3	3324...	0 VA	3	110 A	-	SPARE
27	-	-	-	-	-	3324...	0 VA	-	-	-	-
29	-	-	-	-	-	3324...	0 VA	-	-	-	-
31	EUH-5 - APPARATUS BAY	HVAC	1	20 A	3	3324...	0 VA	3	20 A	-	SPARE
33	-	-	-	-	-	3324...	0 VA	-	-	-	-
35	-	-	-	-	-	3324...	0 VA	-	-	-	-
37	SPARE	-	-	20 A	3	0 VA	0 VA	3	20 A	-	SPARE
39	-	-	-	-	-	0 VA	0 VA	-	-	-	-
41	SPARE	-	-	125 A	3	2979 VA	0 VA	3	30 A	-	SPARE
43	-	-	-	-	-	0 VA	0 VA	-	-	-	-
45	-	-	-	-	-	0 VA	0 VA	-	-	-	-
47	SPARE	-	-	20 A	3	0 VA	0 VA	3	20 A	-	SPARE
49	-	-	-								

PANEL: PP-EM-1

LOCATION: MAIN ELEC 112
 SUPPLY FROM: ATS-EM-1
 MOUNTING: SURFACE
 ENCLOSURE: Type 1

VOLTS: 480/277 Wye
 PHASE: 3
 WIRE: 4

A.I.C. RATING: 22 KAIC
 BUS RATING: 225 A
 MAIN CB: 225 A

CKT	CIRCUIT DESCRIPTION	LC	TRIP	POLES	A		B		C		POLES	TRIP	LC	CIRCUIT DESCRIPTION	CKT	
					1	13 VA	62 VA	25 VA	70 VA	60 VA	100 VA					
1	LTG - STAIR A S-A1	LTG	20 A	1								1	20 A	LTG	LTG - 222, 226	2
3	LTG - CORRIDOR 100A	LTG	20 A	1				25 VA	70 VA			1	20 A	LTG	LEVEL 2 EXIT SIGNS	4
5	LEVEL 1 EXIT SIGNS	LTG	20 A	1						60 VA	100 VA	1	20 A	LTG	LTG - TURN OUT GEAR 106	6
7	LTG - STAIR B	LTG	20 A	1	111 VA	130 VA						1	20 A	LTG	LEVEL 1 EXIT SIGNS	8
9	LTG - STAIR C	LTG	20 A	1				111 VA	390 VA			1	20 A	LTG	LTG - CORRIDOR 121	10
11	LTG - ELEVATOR 1	LTG	20 A	1						128 VA	140 VA	1	20 A	LTG	LEVEL 2 EXIT SIGNS	12
13	LTG - 232, 232A, 232B, 232, 227	LTG	20 A	1	216 VA	250 VA						1	20 A	LTG	LTG - 215, 201, 208, 213, 214A, 214, 215A	14
15	LTG - SITE (NOTE 1)	LTG	20 A	1				174 VA	490 VA			1	20 A	LTG	LTG - SITE (NOTE 1)	16
17	LTG - CORRIDOR 200	LTG	20 A	1						188 VA	6236 VA	3	90 A	HVAC...	TF-EM-1	18
19	LTG - APPARATUS BAY 100	LTG	20 A	1	751 VA	1023 VA						--	--	--	--	20
21	LTG - SITE (NOTE 1)	LTG	20 A	1				122 VA	771 VA			--	--	--	--	22
23	LTG - 100, CANOPY (NOTE 1)	LTG	20 A	1						353 VA	0 VA	1	20 A	--	SPARE	24
25	SPARE	--	90 A	3	0 VA	0 VA						1	20 A	--	SPARE	26
27	--	--	--					0 VA	0 VA			1	20 A	--	SPARE	28
29	--	--	--							0 VA	0 VA	1	20 A	--	SPARE	30
31	SPARE	--	20 A	1	0 VA	0 VA						1	20 A	--	SPARE	32
33	SPARE	--	20 A	1				0 VA	0 VA			1	20 A	--	SPARE	34
35	SPARE	--	20 A	1						0 VA	0 VA	1	20 A	--	SPARE	36
37	SPARE	--	20 A	1	0 VA	0 VA						1	20 A	--	SPARE	38
39	SPARE	--	20 A	1				0 VA	0 VA			1	20 A	--	SPARE	40
41	SPARE	--	20 A	1						0 VA	0 VA	1	20 A	--	SPARE	42
TOTAL LOAD:					2542 VA		2149 VA		7112 VA		TOTAL LOAD:					
TOTAL AMPS:					9 A		8 A		26 A		TOTAL AMPS:					

LOAD CLASSIFICATION

CONNECTED LOAD

DEMAND FACTOR

ESTIMATED DEMAND

PANEL TOTALS

HVAC	5490 VA	100.00%	5490 VA		
LIGHTING (LTG)	4656 VA	125.00%	5820 VA		TOTAL CONN. LOAD: 11567 VA
POWER	2000 VA	100.00%	2000 VA		TOTAL EST. DEMAND: 12692 VA
					TOTAL CONN.: 14 A
					TOTAL EST. DEMAND: 15 A

NOTES:

NOTE 1: PROVIDE METERING FOR SITE LIGHTING CIRCUIT AND CONNECT TO THE POWER MONITORING SYSTEM.

PANEL: PP-LR-1

LOCATION: MAIN ELEC 112
SUPPLY FROM: ATS-LR-1
MOUNTING: SURFACE
ENCLOSURE: Type 1

VOLTS: 480/277 Wye
PHASE: 3
WIRE: 4

A.I.C. RATING: 22 KAIC
BUS RATING: 100 A
MAIN CB: 100 A

CKT	CIRCUIT DESCRIPTION	LC	TRIP	POLES	A		B		C		POLES	TRIP	LC	CIRCUIT DESCRIPTION	CKT
1	ELEV E-1	ELEV	30 A	3	2240 VA	1554 VA					3	20 A	HVAC	ESP-1 - ELEV E-1	2
3	--	--	--	--			2240 VA	1554 VA			--	--	--	--	4
5	--	--	--	--					2240 VA	1554 VA	--	--	--	--	6
7	TF-LR-1	HVAC...	30 A	3	2561 VA	0 VA					3	20 A	--	SPARE	8
9	--	--	--	--			1820 VA	0 VA			--	--	--	--	10
11	--	--	--	--					500 VA	0 VA	--	--	--	--	12
13	SPARE	--	30 A	3	0 VA	0 VA					3	20 A	--	SPARE	14
15	--	--	--	--			0 VA	0 VA			--	--	--	--	16
17	--	--	--	--					0 VA	0 VA	--	--	--	--	18
19	SPARE	--	30 A	3	0 VA	0 VA					3	20 A	--	SPARE	20
21	--	--	--	--			0 VA	0 VA			--	--	--	--	22
23	--	--	--	--					0 VA	0 VA	--	--	--	--	24
25	SPARE	--	20 A	1	0 VA	0 VA					1	20 A	--	SPARE	26
27	SPARE	--	20 A	1			0 VA	0 VA			1	20 A	--	SPARE	28
29	SPARE	--	20 A	1					0 VA	0 VA	1	20 A	--	SPARE	30
31	SPARE	--	20 A	1	0 VA	0 VA					1	20 A	--	SPARE	32
33	SPARE	--	20 A	1			0 VA	0 VA			1	20 A	--	SPARE	34
35	SPARE	--	20 A	1					0 VA	0 VA	1	20 A	--	SPARE	36
37	SPARE	--	20 A	1	0 VA	0 VA					1	20 A	--	SPARE	38
39	SPARE	--	20 A	1			0 VA	0 VA			1	20 A	--	SPARE	40
41	SPARE	--	20 A	1					0 VA	0 VA	1	20 A	--	SPARE	42
TOTAL LOAD:				6143 VA		5338 VA		4091 VA							
TOTAL AMPS:				23 A		20 A		15 A							

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	ESTIMATED DEMAND	PANEL TOTALS
Elevator	6720 VA	100.00%	6720 VA	
HVAC	8303 VA	100.00%	8303 VA	TOTAL CONN. LOAD: 15542 VA
POWER	1000 VA	100.00%	1000 VA	TOTAL EST. DEMAND: 15542 VA
RECEPTACLE (R)	360 VA	100.00%	360 VA	TOTAL CONN.: 19 A
				TOTAL EST. DEMAND: 19 A

NOTES:

PANEL: GPP-1

LOCATION:
SUPPLY FROM: RP-EM-1
MOUNTING: SURFACE
ENCLOSURE: Type 1

VOLTS: 120/208 Wye
PHASE: 3
WIRE: 4

A.I.C. RATING:
BUS RATING: 100 A
MAIN CB: 100 A

CKT	CIRCUIT DESCRIPTION	LC	TRIP	POLES	A		B		C		POLES	TRIP	LC	CIRCUIT DESCRIPTION	CKT						
					933 VA	4250 VA	308 VA														
1	FOP-1 , FOP-2	HVAC	20 A	1	933 VA	4250 VA					1	50 A	HVAC	HB-1	2						
3	FPS-1	HVAC	20 A	1			308 VA								4						
5															6						
7															8						
9															10						
11															12						
13															14						
15															16						
17															18						
19															20						
21															22						
23															24						
25															26						
27															28						
29															30						
31															32						
33															34						
35															36						
37															38						
39															40						
41															42						
TOTAL LOAD:				5183 VA		308 VA		0 VA													
TOTAL AMPS:				44 A		3 A		0 A													
LOAD CLASSIFICATION			CONNECTED LOAD		DEMAND FACTOR		ESTIMATED DEMAND		PANEL TOTALS												
HVAC			5490 VA		100.00%		5490 VA														
									TOTAL CONN. LOAD: 5490 VA												
									TOTAL EST. DEMAND: 5490 VA												
									TOTAL CONN.: 15 A												
									TOTAL EST. DEMAND: 15 A												

NOTES:

NOTE 1: GENERATOR POWER PANEL TO BE SIZED BY GENERATOR VENDOR. PANEL SCHEDULE SHOWN FOR REFERENCE ONLY.

PANEL: RP-LR-1

LOCATION: MAIN ELEC 112
 SUPPLY FROM: TF-LR-1
 MOUNTING: SURFACE
 ENCLOSURE: Type 1

VOLTS: 120/208 Wye
 PHASE: 3
 WIRE: 4

A.I.C. RATING: 22 kAIC
 BUS RATING: 100 A
 MAIN CB: 50 A

CKT	CIRCUIT DESCRIPTION	LC	TRIP	POLES	A		B		C		POLES	TRIP	LC	CIRCUIT DESCRIPTION	CKT
					360 VA	1820 VA	0 VA	1820 VA	0 VA	0 VA				HVAC	
1	RECEPT - ELEV E-1	R	20 A	1	360 VA	1820 VA					2	20 A	HVAC	HVAC CTL RM 119E	2
3	SPARE	-	20 A	2			0 VA	1820 VA			--	--	--	--	4
5	--	--	--	--					0 VA	0 VA	2	20 A	--	SPARE	6
7	SPARE	--	20 A	2	0 VA	0 VA					--	--	--	--	8
9	--	--	--	--			0 VA	0 VA			2	20 A	--	SPARE	10
11	SPARE	--	20 A	2					0 VA	0 VA	--	--	--	--	12
13	--	--	--	--	0 VA	0 VA					2	20 A	--	SPARE	14
15	SPARE	--	20 A	2			0 VA	0 VA			--	--	--	--	16
17	--	--	--	--					0 VA	500 VA	1	20 A	POW...	PLYMOVENT CP - APPARATUS BAY 100	18
19	SPARE	--	20 A	1	0 VA	500 VA					1	20 A	POW...	PLYMOVENT CP - APPARATUS BAY 100	20
21	SPARE	--	20 A	1			0 VA	0 VA			1	20 A	--	SPARE	22
23	SPARE	--	20 A	1					0 VA	0 VA	1	20 A	--	SPARE	24
25	SPARE	--	20 A	1	0 VA	0 VA					1	20 A	--	SPARE	26
27	SPARE	--	20 A	1			0 VA	0 VA			1	20 A	--	SPARE	28
29	SPARE	--	20 A	1					0 VA	0 VA	1	20 A	--	SPARE	30
31	SPARE	--	20 A	1	0 VA	0 VA					1	20 A	--	SPARE	32
33	PREPARED SPACE	--	--	1			--	--			1	--	--	PREPARED SPACE	34
35	PREPARED SPACE	--	--	1					--	--	1	--	--	PREPARED SPACE	36
37	PREPARED SPACE	--	--	1	--	--					1	--	--	PREPARED SPACE	38
39	PREPARED SPACE	--	--	1			--	--			1	--	--	PREPARED SPACE	40
41	PREPARED SPACE	--	--	1					--	--	1	--	--	PREPARED SPACE	42
TOTAL LOAD:					2561 VA		1820 VA		500 VA		TOTAL LOAD:				
TOTAL AMPS:					23 A		17 A		4 A		TOTAL AMPS:				

LOAD CLASSIFICATION		CONNECTED LOAD	DEMAND FACTOR	ESTIMATED DEMAND	PANEL TOTALS		
HVAC		3640 VA	100.00%	3640 VA			
POWER		1000 VA	100.00%	1000 VA	TOTAL CONN. LOAD:		4798 VA
RECEPTACLE (R)		360 VA	100.00%	360 VA	TOTAL EST. DEMAND:		4798 VA
					TOTAL CONN.:		13 A
					TOTAL EST. DEMAND:		13 A

NOTES:



APPENDIX D - STATION ALERTING SYSTEM

Perkins&Will

City of Worcester South Division Fire Station

Station Alerting System Devices Matrix

ROOM	ROOM ID	NOTES	ZONE SEPARATELY FOR AUTOMATIC NIGHT-TIME VOLUME TURN-DOWN (BASE BID)	CEILING MOUNTED COMBINATION SPEAKER & BEACON (PRE-PURCHASE)	WALL MOUNTED COMBINATION SPEAKER & BEACON (PRE-PURCHASE)	CEILING MOUNTED SPEAKER LAY-IN CEILING (BASE BID)	CEILING MOUNTED SPEAKER EXPOSED CEILING MOUNT (BASE BID)	AQUATIC CEILING MOUNTED SPEAKERS (BASE BID)	CEILING MOUNTED BEACON - STEADY PATTERN (PRE-PURCHASE)	WALL MOUNTED BEACON - STEADY PATTERN (PRE-PURCHASE)	CEILING MOUNTED BEACON - STROBE PATTERN (PRE-PURCHASE)	WALL MOUNTED BEACON - STROBE PATTERN (PRE-PURCHASE)	OMNI-DIRECTIONAL SPEAKERS (BASE BID)	OUTDOOR SPEAKERS (BASE BID)	AMBIENT NOISE CONTROL (BASE BID)	VOLUME CONTROL (PRE-PURCHASE)	DORM REMOTE (PRE-PURCHASE)
APPARATUS BAY	100													X	X		X
SCBA FILL	101		X				X						X				
YARD STORAGE	102		X				X						X				
COMPRESSOR ROOM	103	NO A/V IN SPACE															
EMS STORAGE	104	NO A/V IN SPACE															
DEPT STORAGE	105		X					X									
TURNOUT GEAR	106		X					X									
STORAGE RM 1&2	107		X					X									
BAY WC	108		X					X									
BAY CUSTODIAL	109	NO A/V IN SPACE															
SCBA SHOP	110		X					X								X	
MAIN ELEC	111	NO A/V IN SPACE															
EMERGENCY ELEC	112	NO A/V IN SPACE															
EXERCISE	113		X					X								X	
WATER SERVICE	114	NO A/V IN SPACE															
TRAINING	115					X											X
WC 2	116						X										
WC 1	117						X										
WORK ROOM	118							X									
DECON	119							X									
SHOWER WC	120								X								
CORRIDOR	121			X													
ICE	121.3	NO A/V IN SPACE															
CUSTODIAL	122	NO A/V IN SPACE															
WATCH ROOM	123		X	X												X	
CORRIDOR	200				X												
COMPANY OFFICER OFFICE	201	C/O BUNK 201A DORM REMOTE TO CONTROL SPEAKER			X											X	
BUNK ROOM	202				X											X	X
BUNK ROOM	203				X											X	X
BUNK ROOM	204				X											X	X
BUNK ROOM	205				X											X	X
BUNK ROOM	206				X											X	X
BUNK ROOM	207				X											X	X
COMPANY OFFICER OFFICE	208	C/O BUNK 208A DORM REMOTE TO CONTROL SPEAKER			X											X	
BUNK ROOM	209				X											X	X
BUNK ROOM	210				X											X	X
BUNK ROOM	211				X											X	X

ROOM	ROOM ID	NOTES	ZONE SEPARATELY FOR AUTOMATIC NIGHT-TIME VOLUME TURN-DOWN (BASE BID)	CEILING MOUNTED COMBINATION SPEAKER & BEACON (PRE-PURCHASE)	WALL MOUNTED COMBINATION SPEAKER & BEACON (PRE-PURCHASE)	CEILING MOUNTED SPEAKER LAY-IN CEILING (BASE BID)	CEILING MOUNTED SPEAKER EXPOSED CEILING MOUNT (BASE BID)	AQUATIC CEILING MOUNTED SPEAKERS (BASE BID)	CEILING MOUNTED BEACON - STEADY PATTERN (PRE-PURCHASE)	WALL MOUNTED BEACON - STEADY PATTERN (PRE-PURCHASE)	CEILING MOUNTED BEACON - STROBE PATTERN (PRE-PURCHASE)	WALL MOUNTED BEACON - STROBE PATTERN (PRE-PURCHASE)	OMNI-DIRECTIONAL SPEAKERS (BASE BID)	OUTDOOR SPEAKERS (BASE BID)	AMBIENT NOISE CONTROL (BASE BID)	VOLUME CONTROL (PRE-PURCHASE)	DORM REMOTE (PRE-PURCHASE)
																	
BUNK ROOM	212		X													X	X
COMPANY OFFICER OFFICE	213	C/O BUNK 213A DORM REMOTE TO CONTROL SPEAKER	X													X	
DISTRICT CHIEF OFFICE	214	DISTRICT CHIEF BUNK 214A DORM REMOTE TO CONTROL SPEAKER	X													X	
DISTRICT CHIEF OFFICE	215	DISTRICT CHIEF BUNK 215A DORM REMOTE TO CONTROL SPEAKER	X													X	
STUDY	216		X													X	
SERVER	217	NO A/V IN SPACE															
ADA WC	218						X										
ADA WC	219						X										
ADA WC	220						X										
CUSTODIAL	221	NO A/V IN SPACE															
DAY ROOM	222		X													X	
ADA WC	223							X									
ADA WC	224							X									
LAUNDRY	225				X												
KITCHEN DINING	226			X												X	
COMPANY OFFICER OFFICE	227	C/O BUNK 227A DORM REMOTE TO CONTROL SPEAKER	X													X	
BUNK ROOM	228		X													X	X
BUNK ROOM	229		X													X	X
BUNK ROOM	230		X													X	X
BUNK ROOM	231		X													X	X
COMPANY OFFICER OFFICE	232	C/O BUNK 232A DORM REMOTE TO CONTROL SPEAKER	X													X	
CORRIDOR	233		X														
CORRIDOR	100A		X			X											
MEP	102A	NO A/V IN SPACE															
TABLE & CHAIR STOR.	115A	NO A/V IN SPACE															
PPE DRYING ROOM	119A				X												
LAUNDRY	119B					X											
SHOWER LOCKERS	119C					X											
CTL RM	119E	NO A/V IN SPACE															
SHOWERS	120D	LOCATE SPEAKER IN EACH SHOWER/CHANGING STALL					X										
VESTIBULE	121A	NO A/V IN SPACE															
VESTIBULE 1	121B	NO A/V IN SPACE															
VESTIBULE 2	121C	NO A/V IN SPACE															
BUNK	122A		X													X	X

ROOM	ROOM ID	NOTES	ZONE SEPARATELY FOR AUTOMATIC NIGHT-TIME VOLUME TURN-DOWN (BASE BID)	CEILING MOUNTED COMBINATION SPEAKER & BEACON (PRE-PURCHASE)	WALL MOUNTED COMBINATION SPEAKER & BEACON (PRE-PURCHASE)	CEILING MOUNTED SPEAKER LAY-IN CEILING (BASE BID)	CEILING MOUNTED SPEAKER EXPOSED CEILING MOUNT (BASE BID)	AQUATIC CEILING MOUNTED SPEAKERS (BASE BID)	CEILING MOUNTED BEACON - STEADY PATTERN (PRE-PURCHASE)	WALL MOUNTED BEACON - STEADY PATTERN (PRE-PURCHASE)	CEILING MOUNTED BEACON - STROBE PATTERN (PRE-PURCHASE)	WALL MOUNTED BEACON - STROBE PATTERN (PRE-PURCHASE)	OMNI-DIRECTIONAL SPEAKERS (BASE BID)	OUTDOOR SPEAKERS (BASE BID)	AMBIENT NOISE CONTROL (BASE BID)	VOLUME CONTROL (PRE-PURCHASE)	DORM REMOTE (PRE-PURCHASE)
LOCKERS	200A	NO A/V IN SPACE															
LOCKERS	200B	NO A/V IN SPACE															
LOCKERS	200C	NO A/V IN SPACE															
LOCKERS	200D	NO A/V IN SPACE															
LOCKERS	200E	NO A/V IN SPACE															
C/O BUNK ROOM	201A			X											X	X	
C/O BUNK ROOM	208A				X										X	X	
C/O BUNK ROOM	213A				X										X	X	
DISTRICT CHIEF BUNK	214A				X										X	X	
DISTRICT CHIEF BATH	214B.2							X							X		
DISTRICT CHIEF BUNK	215A				X										X	X	
ELEC	222A	NO A/V IN SPACE															
C/O BUNK	227A				X										X	X	
C/O BUNK	232A				X										X	X	
LOCKERS	233A	NO A/V IN SPACE															
LOCKERS	233B	NO A/V IN SPACE															
ELEV	E-1	NO A/V IN SPACE															
FIRE POLE 1	FP-1	NO A/V IN SPACE															
FIRE POLE 2	FP-2	NO A/V IN SPACE															
FIRE POLE 3	FP-3	NO A/V IN SPACE															
OUTDOOR DECK	N/A	DEDICATED ZONE FOR ALL EXTERIOR SPEAKERS	X											X		X	
EXTERIOR PLAN WEST	N/A	(1) SPEAKER AT NW CORNER BY TOWER, DEDICATED ZONE FOR ALL EXTERIOR SPEAKERS		X										X		X	
EXTERIOR PLAN EAST	N/A	(1) SPEAKER AT NE CORNER FOR EXERCISE PAD, DEDICATED ZONE FOR ALL EXTERIOR SPEAKERS		X										X		X	
STAIR A	S-A1		X				X										
STAIR B	S-B1			X				X									
STAIR C	S-C1		X				X										
TRAINING TOWER	T-1	NO A/V IN SPACE															

PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:

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**Bogen Ambient Noise
Sensor System
Installation Cutsheet (CS 001)**

Revision 2

January 16, 2020

Bogen Ambient Noise Sensor System (Control Unit + Microphone Module)

Bogen Ambient Noise Sensor system is designed to monitor continuously changing ambient noise levels and electronically adjust the level of a page announcement, so intelligibility is maintained in FSAS speakers to ensure audible alerting. System consists of a microphone module (ANS500M) (Fig 1) and the control module (Model ANS501) (Fig 2), and a power supply (not shown).

PURVIS P/N: 315-160000-131 (Main Module)

PURVIS P/N: 315-160100-131 (Spare Microphone)



Fig 1 – ANS500 Microphone Module

Microphone Module Drawing Symbol:

Ambient Noise Sensor Drawing Symbol:

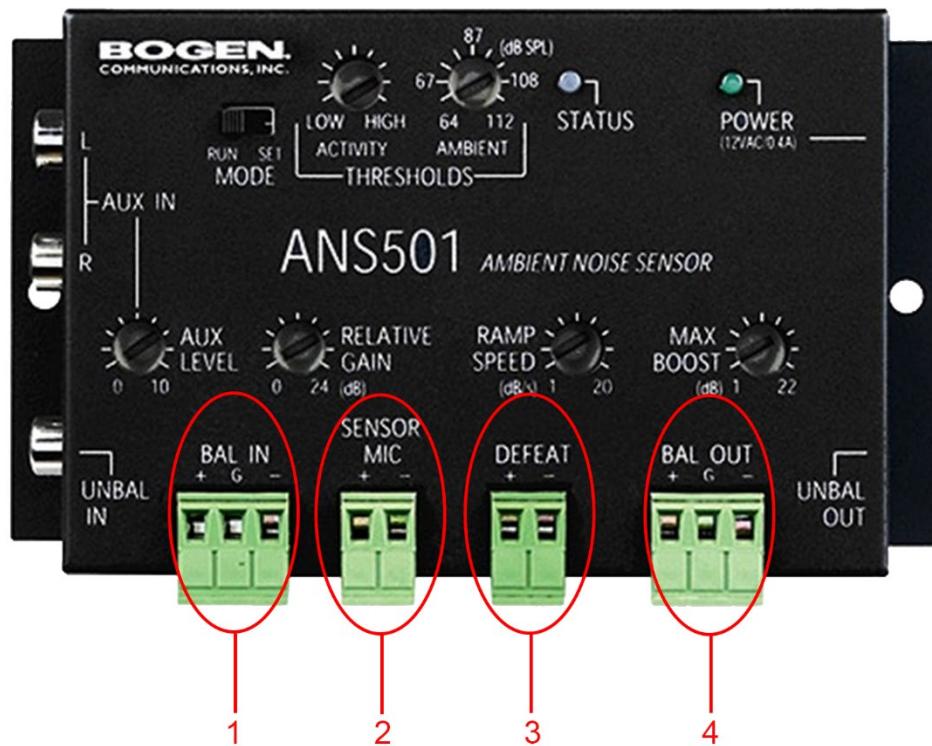


Fig 2 – ANS501 Control Unit

Technical Specifications		
	ANS500M Microphone Module	ANS501 Control Unit
Dimensions	2" W x 21 1/8" H x 7 1/8" D	5 1/4" W x 3" H x 11 1/4" D
Weight	4 oz.	12 oz.
Voltage	12V AC/0.4A	12V AC/0.4A
Connector	RCA & Pluggable Screw Terminals	
Controls	Maximum Boost, Ramp Speed, Activity Threshold, Ambient Threshold, Aux Level, & Relative Gain	
Indicators	Bi-Color Status (Amber/Green); Power (Green)	

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Device Wiring:

ANS501 Ambient Noise Sensor Control Unit			
Fig 2 & 3 Reference	Device	18/2, Shielded (Plenum)	Termination
1	BAL IN +	White	AXM/SCU
	BAL IN -	Black	AXM/SCU
2	SENSOR MIC +	White	ANS500M
	SENSOR MIC -	Black	ANS500M
3	DEFEAT +	Not Used	
	DEFEAT -		
4	BAL OUT+	White	Speaker +
	BAL OUT-	Black	Speaker -

Wiring Notes: 12VAC power supplied by receptacle. Audio signal goes out to corresponding bay speakers. Audio signal originates from AXM or SCU depending on application. Refer to Station Pull Schedule for wiring source.



Fig 3 – ANS501 Control Unit Wiring

Mounting Instructions:

- Typically mounted in engine bays in the fire station. However, if AC power not available in the bay area it can be mounted next to originating audio signal source such as an ARXM or SCU where power will be on UPS backup.
- This unit is wall mounted within distance of an AC receptacle so as to use the included power brick.
- Take precautions when running cable to avoid AC lines, power transformers, fluorescent lighting, radios and other sources of RF as audio signal is susceptible to noise.
- Works in conjunction with ANS500M microphone module which monitors audio level in controlled area.
- ANS500M (Microphone Module) is typically wall mounted throughout bay, if applicable. Ceiling mount is acceptable, if needed.

Ambient Noise Sensor System

Model ANS501
Control Unit

Model ANS500M
Microphone Module



Description The Bogen Ambient Noise Sensor system is designed to monitor continuously changing ambient noise levels and electronically adjust the level of a page announcement and/or background music so intelligibility is maintained. The system consists of the control module (Model ANS501), a microphone module (ANS500M), and a power supply.

The system ensures that page announcements and music are audible even during periods of high noise levels by continuously monitoring the ambient noise level through a microphone module located in the subject area and adjusting the paging signal level into the system's amplifier.

Features

- Consists of an ANS501 control unit, an ANS500M microphone module, and a power supply
- Balanced input and output
- Unbalanced input and output
- Unbalanced stereo AUX inputs (summed mono)
- AUX inputs bypass gain control feature
- Remote defeat connections (to disable level boost)
- Automatically adjusts level of page announcements
- Run/Set mode switch
- ANS501 can be wired in between preamp and power amp or to amplifier insert jacks
- Maximum boost; activity threshold; relative gain; AUX input level; ramp speed; and ambient MIC input threshold controls
- Supports up to four microphones wired in parallel
- Microphone wire run can be up to 2,000 feet with no appreciable loss of signal
- Microphone module includes an adjustable mounting bracket for precise positioning
- Powered by a 12V wall-mounted power supply that operates from 120V AC

BOGEN.

Specifications subject to change without notice.
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**Technical
Specifications**

Gain (Boost):	0 dB to 22 dB (\pm 1 dB)
Frequency Response:	5 Hz to 80 kHz (+0 / -3 dB)
S/N (20 Hz - 20 kHz):	-96 dBV
Distortion:	<0.007%
Input Impedance:	Aux Input: Unbalanced 10 k-ohms Unbalanced Input: 20 k-ohms Balanced Input: 20 k-ohms
Output Impedance:	Unbalanced Output: 300 ohms Balanced Output: 600 ohms
Gain Ramp Speed:	1 dB/s to 20 dB/s
Power:	12V AC/0.4A
Controls:	Maximum Boost, Ramp Speed, Activity Threshold, Ambient Threshold, Aux Level, & Relative Gain
Connector:	RCA & pluggable screw terminals
Product Weight:	12 oz. (ANS501); 4 oz. (ANS500M)
Dimensions:	5 $\frac{1}{4}$ " W x 3" H x 1 $\frac{1}{4}$ " D (ANS501); 2" W x 2 $\frac{1}{4}$ " H x $\frac{7}{8}$ " D (ANS500M)
Indicators:	Bi-Color Status (Amber/Green); Power (Green)

**Architect and
Engineer
Specifications**

The Ambient Noise Sensor system shall consist of a Bogen Model ANS501 control module, a Bogen Model ANS500M microphone module, and a 12V/0.4A wall-mounted power supply. The system shall be designed to electronically adjust the level of a page announcement in an area where ambient noise levels are continuously changing.

The system shall continuously monitor the ambient noise level through the microphone module located in the subject area and change page signal levels to make pages audible over noise.

Up to four (4) microphone modules may be wired in parallel to monitor larger locations. The wire run between control unit and microphone module, when composed of 2-conductor AWG20, shall be able to reach a length of 2,000 feet with no appreciable loss of signal strength.

All wiring connections to the control module shall be made via pluggable screw terminals or RCA jacks.

The control module shall include controls for maximum boost; activity threshold; relative gain; AUX input level; ramp speed; and ambient MIC input threshold.

The control module shall include two unbalanced RCA inputs with mono summing stereo; balanced and unbalanced inputs; balanced and unbalanced outputs; a sensor MIC input; and a defeat input.

The control module shall include a mode switch and power and status LED's.

The control module is designed to be wall-mounted. The microphone module shall include an adjustable mounting bracket for precise positioning.

The system shall be powered by a 12V power supply, which shall operate from 120V AC. Current draw shall not exceed 400 mA.

Dimensions of the control unit shall be 5 $\frac{1}{4}$ " W x 3" H x 1 $\frac{1}{4}$ " D. Dimensions of the microphone module shall be 2" W x 2 $\frac{1}{4}$ " H x $\frac{7}{8}$ " D.

BOGEN[®]
COMMUNICATIONS, INC.

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Web Site: www.bogen.com

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PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:
PURVIS Systems
88 Silva Lane
Middletown RI 02842
401.849.4750 / Fax 401.849.0121

**Bogen 70/25V Recessed Speaker
Installation Cutsheet (CS 007)**

Revision 4

March 15, 2024

Bogen 70/25V Recessed Speaker

The Bogen 70/25V Recessed Speaker (Fig 1), is a ceiling mounted speaker that contain an 8" cone loudspeaker and multi-tap 4-watt 70/25V transformer.

PURVIS P/N: 315-130401-131-SO (Speaker)

PURVIS P/N: 315-130350-131 (Back Box Cover)

PURVIS P/N: 315-130351-131 (Tile Bridge)

PURVIS P/N: 315-130352-131 (Mounting Ring for Drywall)



Fig 1 – Bogen 70/25V Recessed Speaker



Drawing Symbol:

Technical Specifications (Model S86T725PG8WBRVR)	
Dimensions	13" Dia x 3-1/4" Depth
Weight	5.0 lbs.
Voltage	70V or 25V

Device Wiring:

Device	18/2, Shielded (Plenum)
****1WATT TAP****	
Black (Common)	Black (GND)
Blue (1W)	Red (+)
Wiring Notes: Audio signal input typically supplied by the ARXM-HP if zoning is required or directly from the station P/A. Refer to station Pull Schedule and wire list for wiring source.	

Mounting:

- Typically mounted in various rooms around the fire station.
- This unit is installed flush mount in the ceiling (Fig 2).
- Can be daisy chained but not on same home run as high powered Bay speakers.
- Take precautions when running cable to avoid AC lines, power transformers, fluorescent lighting, radios and other sources of RF as audio signal is susceptible to noise.
- Refer to manufacturer installation instructions on page 3.



Fig 2 – Bogen 70/25V Recessed Speaker (Mounted)

Manufacturer's Installation Instructions:

Ceiling Speaker Enclosure & Tile Bridge Models RE84 and TB8

Installation and Use Manual

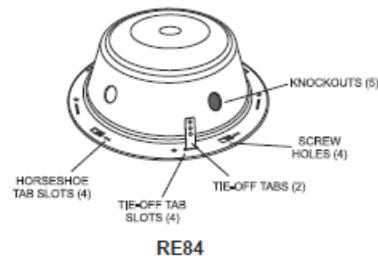
UL LISTED (UUMW) Flush-Mounted Loudspeaker Installation For Use In Return Air Ceiling Plenum Spaces

Enclosures (UL Listed) RE84

Intended for use with: TB8 (Tile Support Bridge)

RE84 Features

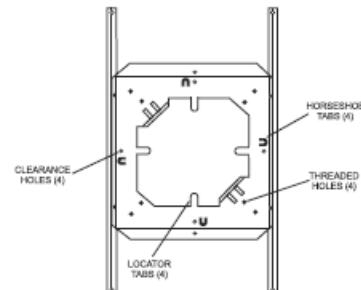
- Listed by Underwriters Laboratories, Inc. Category UUMW. Material and construction permits use where ceiling plenum is part of the air handling system.
- Compound knockout(s) provided for listed type metallic type fittings for $\frac{1}{2}$ " and $\frac{3}{4}$ " plenum rated cable and plenum whip flex conduit.
- Four horseshoe tab slots provided on each enclosure to mate with four horseshoe tabs on TB8 bridge eliminates the need for screws.
- Two seismic tie-off tabs and four tie-off tab slots with enclosure.



RE84

TB8 Features

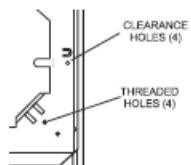
- Distributes the weight of a speaker, grille, and protective enclosure onto the ceiling grid.
- Four locator tabs to prevent sliding on ceiling tile.
- Four horseshoe tabs to mate with four horseshoe tab slots on enclosure.



TB8

A Listed assembly requires that the enclosed loudspeaker is not exposed within the air handling plenum. Wiring, and/or conduit enclosure entry fittings, and installation must comply with local codes. Many local codes require a separate enclosure assembly with customer-supplied "tie-off" wire to secure the assembly to the top of the building structure.

NOTE: All cable splices and connections to Speaker/Transformer pigtailed must be made inside of Listed enclosure.

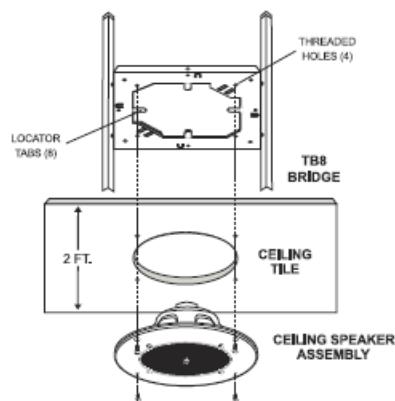


NOTE: When the RE84 and the TB8 are installed together, the clearance holes on the TB8 are used during installation. However, when the TB8 is installed without the RE84, the threaded holes on the TB8 are used during installation.

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Specifications subject to change without notice.
54-2108-01A 0404

TB8 Installation

1. Place ceiling tile with the finished side facing up over a large trash can (provides support and saves clean up time).
2. Cut hole in the center of the ceiling tile using the raw speaker as a template.
3. Position the tile bridge on the unfinished side of the ceiling tile and bend (4) locator tabs into tile opening to prevent sliding.
4. Install Ceiling Speaker assembly using (4) 8-32 screws and the threaded holes of the tile bridge as shown. (Screws are provided with Ceiling Speaker assembly).



Limited Warranty

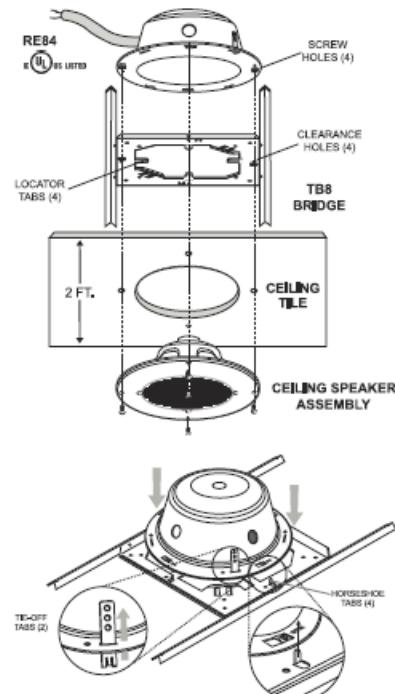
The RE84 and TB8 are warranted to be free from defects in material or workmanship for two (2) years from the date of sale to the original purchaser. Any part of the product covered by this warranty that, with normal installation and use, becomes defective will be repaired or replaced by Bogen, at our option, provided the product is shipped insured and prepaid to: Bogen Factory Service Department, 50 Spring Street, Ramsey, NJ 07446, USA. The product will be returned to you freight prepaid. This warranty does not extend to any of our products that have been subjected to abuse, misuse, improper storage, neglect, accident, Improper installation or have been modified or repaired or altered in any manner whatsoever, or where the serial number or date code has been removed or defaced.

THE FOREGOING LIMITED WARRANTY IS BOGEN'S SOLE AND EXCLUSIVE WARRANTY AND THE PURCHASER'S SOLE AND EXCLUSIVE REMEDY. BOGEN MAKES NO OTHER WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED AND EXCLUDED TO THE MAXIMUM EXTENT ALLOWABLE BY LAW. Bogen's liability arising out of the manufacture, sale or supplying of products or their use or disposition, whether based upon warranty, contract, tort or otherwise, shall be limited to the price of the product. In no event shall Bogen be liable for special, incidental or consequential damages (including, but not limited to, loss of profits, loss of data or loss of use damages) arising out of the manufacture, sale or supplying of products, even if Bogen has been advised of the possibility of such damage or losses. Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

Products that are out of warranty will also be repaired by the Bogen Factory Service Department – same address as above or call 201-934-8500. The parts and labor involved in these repairs are warranted for 90 days when repaired by the Bogen Factory Service Department. All shipping charges in addition to parts and labor charges will be at the owner's expense. All returns require a Return Authorization number.

TB8 with RE84 Installation

1. Place ceiling tile with the finished side facing up over a large trash can (provides support and saves clean up time).
2. Cut hole in the center of the ceiling tile using the raw speaker as a template.
3. Bend (4) horseshoe tabs up on tile bridge.
4. Position the tile bridge on the unfinished side of the ceiling tile and bend (4) locator tabs into tile opening to prevent sliding.
5. Slip seismic mounting tie-off tabs (2) through RE84 tie-off tab slots until they click into place and secure customer-supplied "tie-off" wire to tab.
6. Punch out knockout in the RE84 and install Listed metallic enclosure entry fitting to knockout to accommodate plenum cable or plenum whip and feed cable or whip through the knockout.
7. Install RE84 to tile bridge by orienting horseshoe tab slots (4) over horseshoe tabs (4) of bridge.
8. With pliers, twist horseshoe tabs (4) of tile bridge 1/2 turn, securing enclosure to bridge.
9. Screw the Ceiling Speaker assembly to the RE84 using (4) 8-32 screws provided with the Ceiling Speaker assembly, sandwiching the TB8 and ceiling tile in between. The screws must go through the TB8 clearance holes as shown. (Screws anchor into the RE84).



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Manufacturer's Specs Sheet:

Ceiling Speaker Grille Assemblies



S86T725PG8WBR



S86T725PG8WVK

Description
Bogen's Ceiling Speaker Assemblies consist of an 8" Cone Speaker (S86 or S810) pre-assembled onto a 13" steel ceiling grille painted with off-white (PG8W) or bright white (PG8U) enamel. Options for these assemblies are recessed volume control (VR), volume control with knob (VK), and rear-mounted screw terminal strip for power taps (BR).

- | | | |
|-----------------|--|---|
| Features | <ul style="list-style-type: none"> • 4-watt capacity • 8" cone speaker for excellent audio quality • 6 different power taps available (4, 2, 1, 1/2, 1/4, 1/8W) • T725 4-watt transformer • Off-white enamel over steel grille ("W" versions) • Bright white enamel over steel grille ("U" versions) | <ul style="list-style-type: none"> • Pre-assembled for faster installation • Works with both 70V and 25V amplifier outputs • Available with volume control – recessed or with knob (VR and VK models only) • Screw terminals (BR models only) • 6 oz. or 10 oz. magnet weights |
|-----------------|--|---|

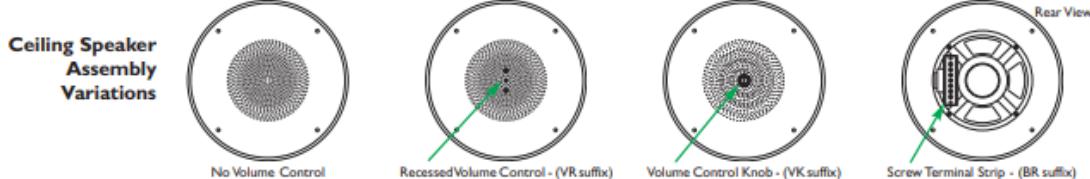
**Technical
Specifications**

Model	Power Taps (in Watts)	Frequency Response	Sensitivity (4 ft./1W)	Magnet Weight	No Volume Control	Recessed Volume Control (VR)	Volume Control w/ Knob (VK)	Screw Terminals (BR)	Off-White (W)	Bright White (U)	Shipping Weight (lb./Carton)	Dimensions	
S86T725PG8W	4, 2, 1, 1/2, 1/4, 1/8 @ 25 & 70V	50 Hz- 12 kHz	95 dBspl	6 oz.	●				●		27 lb. / carton	13" Dia x 3-1/4" D	
S86T725PG8WVR						●			●				
S86T725PG8WVK							●		●				
S86T725PG8WBR					●			●	●		28 lb. / carton		
S86T725PG8WBRVR						●		●	●	●			
S86T725PG8WBRVK							●	●	●	●			
S86T725PG8U					●					●	27 lb. / carton		
S86T725PG8UVR						●				●			
S86T725PG8UVK							●			●			
S86T725PG8UBR					●			●	●	●	28 lb. / carton		
S86T725PG8UBRVR						●		●	●	●			
S86T725PG8UBRK							●	●	●	●			
S810T725PG8W		70 Hz- 15 kHz	96 dBspl	10 oz.	●				●		30 lb. / carton		
S810T725PG8WVR						●			●				
S810T725PG8WVK							●		●				
S810T725PG8U					●			●	●				
S810T725PG8UVR						●		●	●	●			
S810T725PG8UVK							●	●	●	●			

Specifications subject to change without notice.
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54-7777-08A 0808

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**Architect
and Engineer
Specifications**

S86T725PG8W & Variations The loudspeaker assembly shall be a Bogen model **S86T725PG8W** (or **S86T725PG8WVR**, **S86T725PG8WVK**, **S86T725PG8WBR**, **S86T725PG8WBRVR**, or **S86T725PG8WBRVK**), or equivalent, 8" cone-type loudspeaker, having a frequency response of at least 50 Hz to 12 kHz. Axial sensitivity shall be 95 dB, measured at 1-watt/4 feet. The loudspeaker shall have a 6 oz. ceramic magnet and a 3/4" voice coil. A transformer, capable of matching an 8-ohm loudspeaker to a 25-volt or 70-volt line, and providing power taps of 4, 2, 1, 1/2, 1/4, and 1/8 watts shall be included. The loudspeaker shall be assembled on a 13" steel ceiling grille, finished in off-white semi-gloss enamel. Assembly depth shall be 3-1/4".

(For **S86T725PG8WVR** add) A recessed volume control shall be included.

(For **S86T725PG8WVK** add) A volume control knob shall be accessible from the front of the grille.

(For **S86T725PG8WBR** add) A terminal strip shall be included for connection of the audio line.

(For **S86T725PG8WBRVR** add) A terminal strip shall be included for connection of the audio line. A recessed volume control shall be included.

(For **S86T725PG8WBRVK** add) A terminal strip shall be included for connection of the audio line. A volume control knob shall be accessible from the front of the grille.

S86T725PG8U & Variations The loudspeaker assembly shall be a Bogen model **S86T725PG8U** (or **S86T725PG8UVR**, **S86T725PG8UVK**, **S86T725PG8UBR**, **S86T725PG8UBRVR**, or **S86T725PG8UBRVK**), or equivalent, 8" cone-type loudspeaker, having a frequency response of at least 50 Hz to 12 kHz. Axial sensitivity shall be 95 dB, measured at 1-watt/4 feet. The loudspeaker shall have a 6 oz. ceramic magnet and a 3/4" voice coil. A transformer, capable of matching an 8-ohm loudspeaker to a 25-volt or 70-volt line, and providing power taps of 4, 2, 1, 1/2, 1/4, and 1/8 watts shall be included. The loudspeaker shall be assembled on a 13" steel ceiling grille, finished in bright white semi-gloss enamel. Assembly depth shall be 3-1/4".

(For **S86T725PG8UVR** add) A recessed volume control shall be included.

(For **S86T725PG8UVK** add) A volume control knob shall be accessible from the front of the grille.

(For **S86T725PG8UBR** add) A terminal strip shall be included for connection of the audio line.

(For **S86T725PG8UBRVR** add) A terminal strip shall be included for connection of the audio line. A recessed volume control shall be included.

(For **S86T725PG8UBRVK** add) A terminal strip shall be included for connection of the audio line. A volume control knob shall be accessible from the front of the grille.

S810T725PG8W & Variations The loudspeaker shall be a Bogen model **S810T725PG8W** (or **S810T725PG8WVR**, or **S810T725PG8WVK**), or equivalent, 8" cone-type loudspeaker, having a frequency response of at least 70 Hz to 15 kHz. Axial sensitivity shall be 96 dB, measured at 1-watt/4 feet. The loudspeaker shall have a 10 oz. ceramic magnet and a 1" voice coil. A transformer, capable of matching an 8-ohm loudspeaker to a 25-volt or 70-volt line, and providing power taps of 4, 2, 1, 1/2, 1/4, and 1/8 watts shall be included. The loudspeaker shall be assembled on a 13" steel ceiling grille, finished in off-white semi-gloss enamel. Assembly depth shall be 3-1/4".

(For **S810T725PG8WVR** add) A recessed volume control shall be included.

(For **S810T725PG8WVK** add) A volume control knob shall be accessible from the front of the grille.

S810T725PG8U & Variations The loudspeaker shall be a Bogen model **S810T725PG8U** (or **S810T725PG8UVR**, or **S810T725PG8UVK**, or **S810T725PG8UBR**, or **S810T725PG8UBRVR**), or equivalent, 8" cone-type loudspeaker, having a frequency response of at least 70 Hz to 15 kHz. Axial sensitivity shall be 96 dB, measured at 1-watt/4 feet. The loudspeaker shall have a 10 oz. ceramic magnet and a 1" voice coil. A transformer, capable of matching an 8-ohm loudspeaker to a 25-volt or 70-volt line, and providing power taps of 4, 2, 1, 1/2, 1/4, and 1/8 watts shall be included. The loudspeaker shall be assembled on a 13" steel ceiling grille, finished in bright white semi-gloss enamel. Assembly depth shall be 3-1/4".

(For **S810T725PG8UVR** add) A recessed volume control shall be included.

(For **S810T725PG8UVK** add) A volume control knob shall be accessible from the front of the grille.

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PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:

PURVIS Systems

88 Silva Lane

Middletown RI 02842

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**Dorm Remote
Installation Cutsheet (CS 010)**

Revision 3

July 27, 2020

Dorm Remote

Dorm Remote (Fig 1) provides personnel the ability to select a unit based type of alert for a specific room. A single Dorm Remote can select up to eight (8) types of units and control both individual lights and speakers in a designated area.

PURVIS P/N: 315-410000-131

Additional items:

PURVIS P/N: 315-410200-129 (Dorm Remote Graphics – Standard 5 Unit Overlay)

PURVIS P/N: 315-410200-129 Mont (Dorm Remote Graphics – Montgomery County Overlay)

PURVIS P/N: 315-410200-129-Gray 1/8 (Dorm Remote Graphics – Gray 1-8 Overlay)

PURVIS P/N: 315-410300-129-Color 1/8 (Dorm Remote Graphics – Color 1-8 Overlay)

PURVIS P/N: 315-410300-100-16 (Cable Harness – Used on Dorm Remote Gateway 2,4,16 Port)

PURVIS P/N: 315-410300-100-32 (Cable Harness – Used on Dorm Remote Gateway 32 Port)

PURVIS P/N: 315-410400-100 (Custom 2 Gang Plate)



Fig 1 – Dorm Remote

Drawing Symbol:



Technical Specifications	
Dimensions	4.5" H x 2.75" W
Weight	NA
Voltage	+5VDC at .070A

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Device Wiring:

Device	18/4 Twisted Pair Shielded (Plenum)
PWR +	Red
PWR -	Black
D+	White
D-	Green

Wiring Notes: Requires 18/4 Twisted Pair, shielded (Plenum) cable from the FSAS Dorm Remote Gateway. 5VDC power is supplied by the SCU.

Terminating Resistor: Wired across existing Dorm Remote cable harness 120Ohm Resistor across D+ (White Pin 3) and D- (Green Pin 4).

Mounting:

- Typically mounted on walls in dorm or bunk rooms (Fig 2, 3, and 4).
- Mounts in a single gang 3" box and supplied with a single gang plate as shown in Figure 1.
- Wall 48" AFF.



Fig 2 – Wall Mounted Dorm Remote



Fig 3 – Multi-Color Dorm Remote (Lit)



Fig 4 – Multi-Color Dorm Remote

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PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:

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88 Silva Lane

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**CyberPower PR1500RT2UN UPS
(Rack/Tower Mounted)
Installation Cutsheet (CS 034)**

Revision 2

April 1, 2020

CyberPower PR1500RT2UN Uninterrupted Power Supply (UPS) (Rack/Tower Mounted)

The CyberPower PR1500RT2UN (Fig 1, 2, and 3) is a Smart App Sinewave rack/tower convertible UPS with line-interactive topology, surge protection, and battery backup. CyberPower's New Smart App Sinewave series has sine wave output to eliminate power gaps that can be detected by sensitive equipment and cause unexpected shutdowns.

The Smart App Sinewave PR1500RT2UN improves battery life through battery equalization technology and Automatic Voltage Regulation (AVR), which corrects minor power fluctuations without switching to battery power. The enhanced chassis design with an easy-to-access toolless front panel, color-coded rear panel, and captive screws for battery panel access make installations and battery changes simple and fast. The PR1500RT2UN also has an innovative LCD panel that rotates 90°, tilts for a better viewing angle, and provides information on 47 different settings including UPS stats, UPS setup and control management, and testing options.

PURVIS P/N: 315-040308-131 (PR1500RT2UN)

PURVIS P/N: 315-040308-131 (PR1500LCDRT2UN (EOL))



Fig 1 – CyberPower PR1500RT2UN UPS (Front)



Fig 2 – CyberPower PR1500RT2UN UPS (Display)

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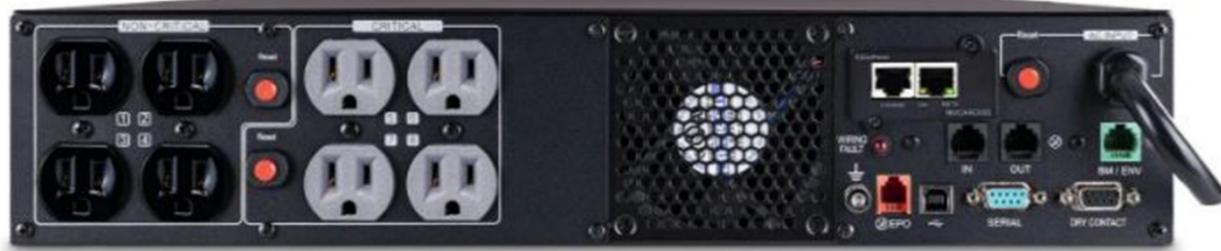


Fig 3 – CyberPower PR1500RT2UN UPS (Rear)

Drawing Symbol:

Technical Specifications (Model PR1500RT2UN)	
Dimensions	17.1" W x 3.4" H x 16.2" D (UPS)
Weight	55.8 lbs.
Output Voltage	120 VAC \pm 5%
Outlet Types	8 x NEMA 5-15R

Configuration: The UPS requires configuration prior to install. This configuration can be conducted in the installer's facility in accordance with the "PURVIS FSAS UPS-PR1500 LCD Setup Document" (P/N 315-040304-133).

Device Wiring:**CAT5- RJ45 Terminated (568B)**

RJ45 Pin #	CAT5 Color Code
1	White/Orange
2	Orange
3	White/Green
4	Blue
5	White/Blue
6	Green
7	White/Brown
8	Brown

Wiring Notes: Requires dedicated 120VAC/15A circuit from a customer supplied electrical source that is preferably on a generator backup. It supplies power to all critical FSAS devices. A Cat5e Network connection to the FSAS LAN is needed as well for system monitoring.

Mounting: UPS is rack/tower mounted.

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Manufacturer's Specs Sheet:**CyberPower
PR1500RT2UN
SMART APP
SINEWAVE UPS**

Protect corporate and network servers, telecom installations, and VoIP systems.



The PR1500RT2UN is a Smart App Sinewave rack/tower convertible UPS with line-interactive topology, surge protection, and battery backup. CyberPower's New Smart App Sinewave series has sine wave output to eliminate power gaps that can be detected by sensitive equipment and cause unexpected shutdowns.

The Smart App Sinewave PR1500RT2UN improves battery life through battery equalization technology and Automatic Voltage Regulation (AVR), which corrects minor power fluctuations without switching to battery power. The enhanced chassis design with an easy-to-access toolless front panel, color-coded rear panel, and captive screws for battery panel access make installations and battery changes simple and fast. The PR1500RT2UN also has an innovative LCD panel that rotates 90°, tilts for a better viewing angle, and provides information on 47 different settings including UPS stats, UPS setup and control management, and testing options.

TYPICAL APPLICATIONS

- Servers
- Workstations
- Network Devices
- Telecom Equipment

FEATURES

- 1500VA/1500W
- Line-Interactive Topology
- GreenPower UPS™
- 2U Rack Mount/Tower Convertible

SPECIFICATIONS**GENERAL**

UPS Topology	Line-Interactive
Energy Saving	GreenPower UPS™ Bypass Technology
ENERGY STAR® Certified	Yes
Active PFC Compatible	Yes

INPUT

Voltage	100 - 125 VAC
Frequency	47 - 63 Hz
Input Voltage Range	75 - 149 VAC
Plug Type	NEMA 5-15P
Plug Style	Right Angle, 45° Offset Right
Cord Length	10 FT

OUTPUT

VA	1500
Watts	1500
Automatic Voltage Regulation	Double Boost, Single Buck
On Battery Voltage	100/110/120/125Vac ± 5%
On Battery Frequency	50/60Hz +/- 1%
On Battery Waveform	Sine Wave
Outlets - Total	8
Outlet Type	NEMA 5-15R
Outlets - Critical Load	4
Outlets - Battery & Surge Protected	8

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**PR1500RT2UN
SMART APP SINEWAVE UPS****SPECIFICATIONS CONT.****OUTPUT CONT.**

Rated Power Factor	1
Overload Protection	Internal Circuitry Limiting/ Circuit Breaker
Transfer Time	4 ms typical

BATTERY

Runtime at Half Load (min)	18.2
Runtime at Full Load (min)	6.5
Battery Type	Sealed Lead-Acid
Battery Size	12 V / 9A H
Hot-Swappable	Yes
Replacement Battery	RB1290X4J
Battery Quantity	4
User Replaceable	Yes
Typical Recharge Time	3 Hrs
External Battery Pack Option	No

SURGE PROTECTION & FILTERING

Network Protection RJ45	1 - In, 1 - Out
Surge Suppression	2430
EMI/RFI Filtration	Yes

MANAGEMENT & COMMUNICATIONS

Multifunction LCD Panel	47 Settings (27 Setup and Control Items + 20 Status Updates and Log Menus)
HID Compliant USB Port	Yes
Serial Port	Yes
EPO Port	Yes
Contact Closure	Yes
Management Cable	USB Cable, EPO Cable

MANAGEMENT & COMMUNICATIONS

LED Indicators	Power On, Line Mode, Battery Mode, Fault, Night Mode, Wiring Fault
Audible Alarms	Battery Mode, Low Battery, Overload, Overcharge, Overheat
Software	PowerPanel® Business Edition
SNMP/HTTP Remote Monitoring	Yes - pre-installed RMCARD205

PHYSICAL

Rack Size	2U
Form Factor	Rack/Tower
Dimensions (WxHxD) (in.)	17.1 x 3.4 x 16.2
Weight (lbs.)	55.8
Shipping Dimensions (WxHxD) (in.)	22.1 x 10.8 x 20.9
Shipping Weight (lbs.)	63.7

ENVIRONMENTAL

Operating Temperature	32° F to 104° F (0° C to 40° C)
Operating Relative Humidity	0 - 95% (Non-Condensing)
Storage Temperature	5° F to 113° F (-15° C to 45° C)
Maximum Operating Elevation	10,000 ft (3,000 m)
Maximum Storage Elevation	50,000 ft (15,000 m)
AC Mode Thermal Dissipation	75.1

CERTIFICATIONS

Safety	UL1778, cUL1071, FCC Class B
Environmental	RoHS Compliant

WARRANTY

Product Warranty	Three-Years Limited
Connected Equipment Guarantee	Lifetime
CEG Amount	\$400,000

Manufacturer's User Manual Link:https://dl4jz3rbrsfum.cloudfront.net/documents/CyberPower_UM_PR1500RT2UN.pdf

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PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:
PURVIS Systems
88 Silva Lane
Middletown RI 02842
401.849.4750 / Fax 401.849.0121

Bogen SPT15A (25/70V)
Loudspeaker
Installation Cutsheet (CS 043)

Revision 1

November 19, 2021

Bogen SPT15A (25/70V) Loudspeaker

The Bogen SPT15A (25/70V) Loudspeaker (Fig 1) is a compact, high intelligibility, reentrant type loudspeakers, designed for one-way or two-way sound and communication systems. Its sturdy, weatherproof, all-metal construction is ideal for indoor and outdoor use in industrial plants, warehouses, schools, construction sites, transportation terminals, and recreational areas.

The Bogen SPT15A has a built-in, rotary impedance selector switch for matching the speaker power requirements to a 25V or 70V constant-voltage line.

PURVIS P/N: 315-150408-131



Fig 1 – Bogen SPT15A Loudspeaker

Drawing Symbol:



Technical Specifications	
Dimensions	9" Diameter X 9-1/4" D
Weight	4 lbs.
Voltage	25/70V, 15W Continuous/20W Equalized

Device Wiring:

<i>Device</i>	<i>18/2, Shielded (Plenum)</i>
*****7.5WATT TAP*****	
Black (Common)	Black (GND)
Blue (1W)	Red (+)

Wiring Notes: Audio signal input typically supplied by the ARXM-HP if zoning is required or directly from the station P/A. Refer to station Pull Schedule and wire list for wiring source.

Mounting:

- Typically mounted in drive bays, outdoors, or other large areas (Fig 2). This unit is wall, ceiling or beam mountable.
- If installed outdoors the unit is designed to be weatherproof so long as the bump on the access cover is on a downward slope as to allow the draining of water
- Can be daisy chained but no more than six (6) speakers max.
- Take precautions when running cable to avoid AC lines, power transformers, fluorescent lighting, radios, and other sources of RF as audio signal is susceptible to noise



Fig 2 – Wall Mounted Bogen SPT15A Loudspeaker

Manufacturer's Description and Features:**Reentrant Horn
Loudspeakers****Models SPT15A
and SP158A**

Description	<p>The Bogen SPT15A and SP158A are compact, high intelligibility, reentrant type loudspeakers, designed for one-way or two-way sound and communication systems. Their sturdy, weatherproof, all-metal construction is ideal for indoor and outdoor use in industrial plants, warehouses, schools, construction sites, transportation terminals, and recreational areas.</p>	<p>The Model SPT15A has a built-in, rotary impedance selector switch for matching the speaker power requirements to a 25V or 70V constant-voltage line. The model SP158A has an 8-ohm impedance only.</p>
Features	<ul style="list-style-type: none">• High intelligibility and efficiency; ideal for both one-way and talk back applications• Weatherproof, all-metal construction• 15 watts; 25/70 volt (SPT15A) or 8-ohm (SP158A) operation• Tap settings for 70V: 15, 7.5, 3.8, 1.8, 0.9 watts; for 25V: 15, 7.5, 1.8, 0.94, 0.46 watts• Rotary tap impedance selector on SPT15A• Tilt and swivel base for easy positioning• Screw terminals make installation fast and easy	<ul style="list-style-type: none">• All-purpose mounting bracket• Self-aligning, field replaceable diaphragm• Mocha enamel finish• Limited lifetime warranty• Mountable to I-beam flange using Bogen's BC1 Beam Clamp (sold separately)• Mountable to electrical box using Bogen's HSES10 mounting strap (sold separately)• Terminal Cover (TCSPT1) allows connection of conduit fittings to horn speakers (sold separately)

BOGEN®

Specifications subject to change without notice.
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54-7612-05D 0904

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**Technical
Specifications**

Power Rating (RMS):	15 watts continuous, 20 watts equalized																																																								
Frequency Response:	275 Hz to 14 kHz																																																								
Impedance:																																																									
SPT15A —	25/70 volts																																																								
SP158A —	8 ohms																																																								
Sound Pressure Level:	121 dB @ four feet on axis with 15 watt input @ 1000 Hz																																																								
Dispersion:	110°																																																								
Sensitivity as Microphone:	-22 dBm [Ref: 10 dynes/cm ²]																																																								
Dimensions:	9" Diameter x 9-1/4" D																																																								
Product Weight:																																																									
SPT15A —	4 lb.																																																								
SP158A —	3 lb.																																																								
Finish:	Textured mocha enamel																																																								
Impedance Selector Switch Settings (SPT15A only):	25V @ 15, 7.5, 1.8, 0.94, 0.46 watts 70V @ 15, 7.5, 3.8, 1.8, 0.9 watts																																																								
Sound Pressure Level in dB @ 1000Hz:	<table><thead><tr><th></th><th>Watts</th><th colspan="5">Feet on Axis</th></tr><tr><th>Input:</th><th></th><th>4</th><th>8</th><th>16</th><th>32</th><th>64</th></tr></thead><tbody><tr><td>15</td><td></td><td>121</td><td>115</td><td>109</td><td>103</td><td>97</td></tr><tr><td>7.5</td><td></td><td>118</td><td>112</td><td>106</td><td>100</td><td>94</td></tr><tr><td>3.8</td><td></td><td>115</td><td>109</td><td>103</td><td>97</td><td>91</td></tr><tr><td>1.8</td><td></td><td>112</td><td>106</td><td>100</td><td>94</td><td>88</td></tr><tr><td>0.9</td><td></td><td>109</td><td>103</td><td>97</td><td>91</td><td>85</td></tr><tr><td>0.46</td><td></td><td>106</td><td>100</td><td>94</td><td>88</td><td>82</td></tr></tbody></table>		Watts	Feet on Axis					Input:		4	8	16	32	64	15		121	115	109	103	97	7.5		118	112	106	100	94	3.8		115	109	103	97	91	1.8		112	106	100	94	88	0.9		109	103	97	91	85	0.46		106	100	94	88	82
	Watts	Feet on Axis																																																							
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3.8		115	109	103	97	91																																																			
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0.9		109	103	97	91	85																																																			
0.46		106	100	94	88	82																																																			

**Architect
and Engineer
Specifications**

The loudspeaker shall be a Bogen Model ____ (specify SPT15A or SP158A), or approved equal, reentrant type horn loudspeaker. The frequency response shall be 275 Hz to 14 kHz. Rated power output shall be 15 watts, RMS continuous. Dispersion shall be 110°. Sound pressure level, measured four feet on axis with 15 watt input @ 1000 Hz, shall be at least 121 dB.

Use for SPT15A. The unit shall incorporate a seven-position weather-sealed switch, to allow matching the loudspeaker to a 25V or 70V constant-voltage line. Power handling capacity shall be adjustable at 70V to 0.9, 1.8, 3.8, 7.5, or 15 watts, and at 25V to 0.46, 0.94, 1.8, 7.5, or 15 watts.

Use for SP158A. The unit shall have an impedance of 8 ohms.

The loudspeaker shall be of weatherproof, all-metal construction, with driver enclosed within a weatherproof housing. The loudspeaker shall include a self-aligning, field-replaceable diaphragm.

Screw terminals shall be provided for connection to the audio line. A plastic cover shall be provided to protect the connectors and impedance selector switch, and provide strain relief for the audio line.

An all-purpose mounting bracket shall provide precise positioning in the vertical and horizontal planes with a single adjustment. The bracket shall include banding slots to permit mounting the loudspeaker on beams or pillars. Bracket and loudspeaker shall be finished in textured mocha enamel. The unit shall measure 9" diameter by 9-1/4" D. Product weight shall be _____ (insert 4 lb. for SPT15A, 3 lb. for SP158A).

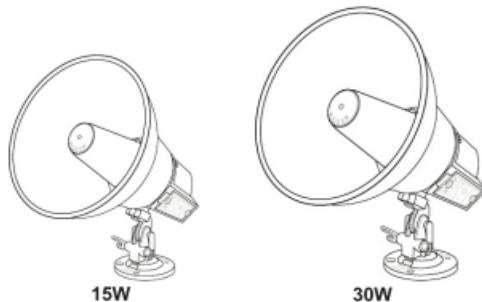
BOGEN®
COMMUNICATIONS, INC.

50 Spring Street, Ramsey, NJ 07446, U.S.A.
Tel. 201-934-8500; FAX: 201-934-9832; www.bogen.com

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Manufacturer's Installation Instructions:**SP158A, SPT15A,
SP308A, SPT30A**

15/30-Watt Horn Loudspeakers

**Installation Instructions**

STEP 1 - For easier installation, remove the mounting base from the speaker by unscrewing the wing nut while at the same time pressing inwardly on the wing nut. Place the mounting base flush on the mounting surface and mark the location of the three holes with either a marker or chisel. It is important that the three holes be exactly aligned with the mounting base, otherwise you might stress the base or make the connection unsteady. Use appropriate hardware for your specific mounting surface.

NOTE: Speaker may also be strap-mounted through the slot in mounting base using standard 1/2-inch industrial strapping (not included).

STEP 2 - After mounting the base, reattach the speaker and aim the speaker for the desired coverage angle. A 45° downward angle is recommended, but this may vary depending upon speaker layout. Unless otherwise indicated, do not aim speakers directly at each other or poor paging intelligibility may occur.

STEP 3 - Remove the plastic cover to expose the connecting screws (see Figure 2). Strip the ends of the connecting wires about 1/4" and connect them to the terminals. The terminals are numbered to indicate phasing.

Provide cable strain relief by laying the cables within the recess on the casting and holding it tight with the plastic cover. The narrow recess is for two-conductor cable; the wide recess is for shielded cable.

Connect wires as listed below:

Amplifier Output	Speaker Connections
70V, 25V, or 8 ohms	Terminal 1
COM	Terminal 2

NOTE: These are recommended connections. The speaker will also work perfectly well with these connections reversed, but be consistent in wiring connections.

STEP 4 - Adjust the tap set control to the desired setting. See table (Figure 3 on next page) for tap settings and sound pressure levels for the different horn loudspeakers. Replace the plastic protective cover back over the exposed area.

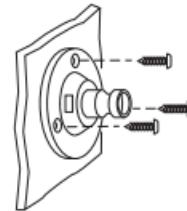


Figure 1. Mounting Base and Strap Mounting Slot

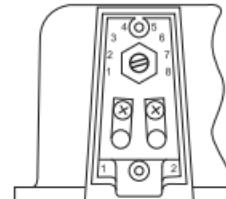


Figure 2. Tap Set Control and Connecting Screw Terminals (SPT15A/SPT30A only)

Figure 3

Tap Set	SPT15A				SPT30A			
	@25V		@70V		@25V		@70V	
	Watts	dBspl*	Watts	dBspl*	Watts	dBspl*	Watts	dBspl*
1	—	—	0.9	109	—	—	1.8	113
2	—	—	1.8	112	—	—	3.7	116
3	0.48	106	3.8	118	—	—	7.5	119
4	0.94	109	7.5	121	1.8	113	15.0	122
5	1.8	112	15.0	121	3.7	116	30.0	125
6	7.5	118	—	—	7.5	119	—	—
7	15.0	121	—	—	15.0	122	—	—
8	Not Used		Not Used		Not Used		Not Used	

* at four feet

Technical Specifications

	SP158A	SPT15A	SP308A	SPT30A
Power Rating (RMS)	15 watts continuous, 20 watts equalized		30 watts continuous, 40 watts equalized	
Frequency Response	275Hz to 14kHz		225Hz to 14kHz	
Impedance	8 ohms	25/70 volts	8 ohms	25/70 volts
Sound Pressure Level	121dB @ 4 feet on axis with 15 watt input @ 1000Hz	125dB @ 4 feet on axis with 30 watt input @ 1000Hz		
Dispersion	110°		100°	
Dimensions	9" Diameter x 9-1/4" D		11" Diameter x 10-1/2" D	
Shipping Weight	4 lb.	4-1/2 lb.	6 lb.	6 lb.
Finish	Textured mocha enamel			

LIMITED WARRANTY; EXCLUSION OF CERTAIN DAMAGES

The Bogen SP158A, SPT15A, SP308A, and SPT30A Horn Speakers are warranted to be free from defects in material and workmanship from the date of sale to the original purchaser for the lifetime of the products. Any part of the product covered by this warranty that, with normal installation and use, becomes defective (as confirmed by Bogen upon inspection) during the applicable warranty period, will be repaired or replaced by Bogen, at Bogen's option, provided the product is shipped insured and prepaid to: Bogen Factory Service Department: 4570 Shelby Air Drive, Suite 11, Memphis, TN 38118, USA. Repaired or replacement product will be returned to you freight prepaid. This warranty does not extend to any of our products that have been subjected to abuse, misuse, improper storage, neglect, accident, improper installation or have been modified or repaired or altered in any manner whatsoever, or where the serial number or date code has been removed or defaced.

THE FOREGOING LIMITED WARRANTY IS BOGEN'S SOLE AND EXCLUSIVE WARRANTY AND THE PURCHASER'S SOLE AND EXCLUSIVE REMEDY. BOGEN MAKES NO OTHER WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED AND EXCLUDED TO THE MAXIMUM EXTENT ALLOWABLE BY LAW. Bogen's liability arising out of the manufacture, sale or supplying of products or their use or disposition, whether based upon warranty, contract, tort or otherwise, shall be limited to the price of the product. IN NO EVENT SHALL BOGEN BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, LOSS OF DATA OR LOSS OF USE DAMAGES) ARISING OUT OF THE MANUFACTURE, SALE OR SUPPLYING OF PRODUCTS, EVEN IF BOGEN HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR LOSSES. Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

Products that are out of warranty will also be repaired by the Bogen Factory Service Department – same address as above or call 201-934-8500. The parts and labor involved in these repairs are warranted for 90 days when repaired by the Bogen Factory Service Department. All shipping charges in addition to parts and labor charges will be at the owner's expense. All returns require a Return Authorization number. For most efficient warranty or repair service, please include a description of the failure.

11/2014

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PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:

PURVIS Systems

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**Lowell 100W Volume Control
Installation Cutsheet (CS 044)**

Revision 1

November 23, 2021

Lowell 100W Volume Control

The Lowell 100W Volume Control (Fig 1 and Fig 2) is a compact, easy-install volume controls with rotary switch provide precise level adjustment of single or multiple speaker lines.

PURVIS P/N: 315-110003-131



Fig 1 – Lowell 100W Volume Control (Front View)



Fig 2 – Lowell 100W Volume Control (Side View)

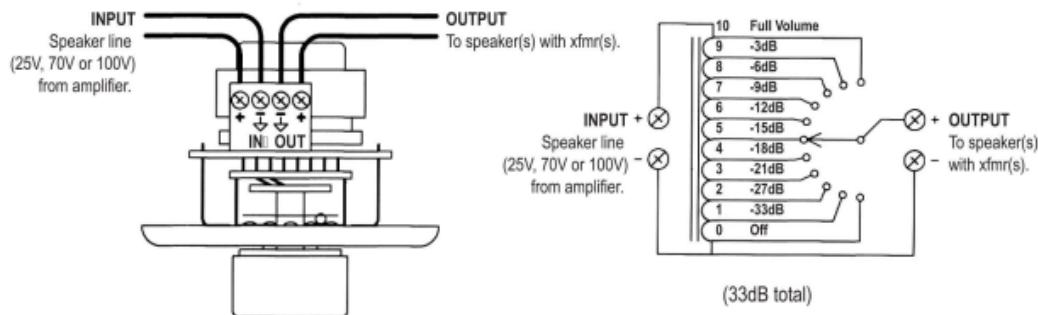
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**Drawing Symbol:**

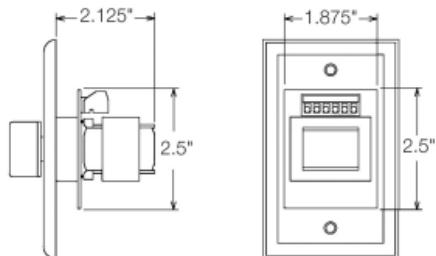
Technical Specifications (Models 13774 (Blank Plate) and 13776)	
Dimensions	2.9" W x 4.6" H x 2.5" D
Weight	2.0 oz.

Device Wiring:

- Wired between the audio source/zone and speakers to be controlled
 - Volume Control – Single gang 4" deep box
 - Volume Controls – 48"
- Wiring schematic is provided in Figure 3.

**Fig 3 – Volume Control Wiring Schematic****Mounting:**

- Volume controls is typically mounted (Fig 4) in various rooms around the fire station that require independent volume control of self-amplified speakers.

**Mounts E.O. Boxes:**

- Lowell surface box (P1X)
- 4" Sq. x 2.125"D with raised mud ring (RACO 232, 235, or equiv.)
- One-gang handy box 2.125"D (RACO 670, 671, 678, or equiv.)

Note: Lowell 100W LVC volume controls are deeper than other other LVC models so a one-gang handy box will allow only minimal room for control and wiring.

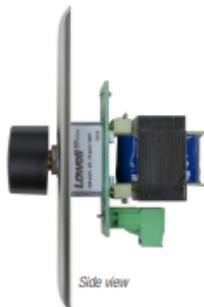
Fig 4 – Mounting Diagram

Manufacturer's Description and Specifications:**100W Attenuator: 100LVC**

Volume control with wall plate provides precise level adjustment of single or multiple speaker lines.

FEATURES:

- Mono autoformer attenuator with rotary switch for use with 25V/70V/100V speaker line
- 100W power rating
- 3dB per step attenuation (33dB total, two steps of 6dB each before off)
- Phoenix style plug-in screw termination strips for pre-wire convenience
- Wire capacity to 14 gauge
- Standard one-gang stainless steel wall plate (2.75" x 4.5"), with printing
- Rotary switch, non-continuous rotation — Off-max (10)
- Designed to fit a standard one-gang E.O. box with minimum depth of 2.125" (box not included)
- ETL Listed
- Assembled in the U.S.A. with global components

**A&E SPECIFICATIONS:**

The ETL Listed volume control shall be Lowell model 100LVC, which shall have a 100W power rating and attenuation of 3dB per step with two steps of 6dB each before off. The volume control with rotary knob shall feature a standard one-gang stainless steel wall plate (2.75" x 4.5") with printing. The device shall be able to mount in an E.O. box with minimum inside dimensions of 1.875"W x 2.688"H x 2.125"D (not included).

OPTIONS: (order separately)

- P1X: One-gang steel surface box with knockouts and white finish. 4.625"H x 2.875"W x 2.5"D. Includes two U-clips.

100LVC Series Attenuator Summary[†]

Model No.	Power Rating	Attenuation *	Type	Switch	Style	Color	For Use With
100LVC	100W	3dB steps	Auto-trans	Rotary	Standard Wall Plate	SS	25V/70V/100V Speaker Line
100LVC-SA	100W	3dB steps	Auto-trans	Rotary	Standard Wall Plate	Almond	25V/70V/100V Speaker Line
100LVC-SW	100W	3dB steps	Auto-trans	Rotary	Standard Wall Plate	White	25V/70V/100V Speaker Line
100LVC-DA	100W	3dB steps	Auto-trans	Rotary	Decorator Wall Plate	Almond	25V/70V/100V Speaker Line
100LVC-DB	100W	3dB steps	Auto-trans	Rotary	Decorator Wall Plate	Black	25V/70V/100V Speaker Line
100LVC-DW	100W	3dB steps	Auto-trans	Rotary	Decorator Wall Plate	White	25V/70V/100V Speaker Line
100LVC-DSB	100W	3dB steps	Auto-trans	Rotary	Decorator Wall Plate	SS & Black	25V/70V/100V Speaker Line
100LVC-DSW	100W	3dB steps	Auto-trans	Rotary	Decorator Wall Plate	SS & White	25V/70V/100V Speaker Line
100LVC-RM	100W	3dB steps	Auto-trans	Rotary	Adhesive Label **	Black	25V/70V/100V Speaker Line

[†]Note: There is also a 100LVC-PA Series, which includes a priority relay.

*3dB total; two steps of 6dB each before off

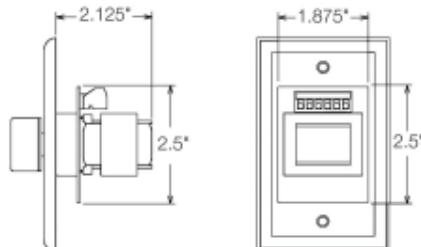
**For rackmount panel



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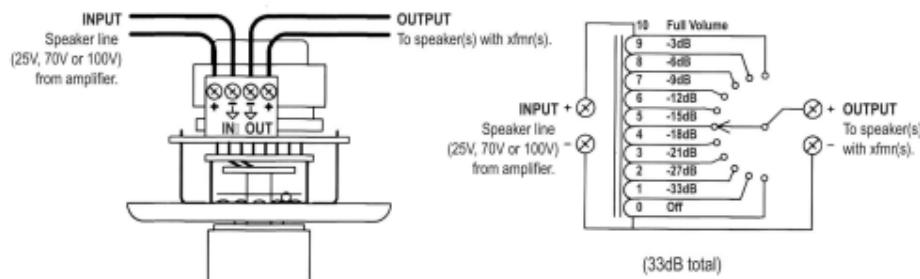
Spec 1792

Model 100LVC Rev. 02-10-21 | pg. 1/2

**Mounts E.O. Boxes:**

- Lowell surface box (P1X)
- 4" Sq. x 2.125"D with raised mud ring (RACO 232, 235, or equiv.)
- One-gang handy box 2.125"D (RACO 670, 671, 678, or equiv.)

Note: Lowell 100W LVC volume controls are deeper than other other LVC models so a one-gang handy box will allow only minimal room for control and wiring.



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Spec 1792
Model 100LVC Rev 02-10-21 | pg. 2/2

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PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:

PURVIS Systems

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**Drive Bay Speaker
(Soundsphere Q-6)
Installation Cutsheet (CS 048)**

Revision 1

September 15, 2022

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Drive Bay Speaker (Soundsphere Q-6)

The Drive Bay Speaker (Soundsphere Q-6) (Fig 1) is a compact and weatherproof loudspeaker used in Fire Station Drive Bays employing PURVIS' Fire Station Alerting System (FSAS). The Soundsphere Q-6 offers hemispherical omnidirectional full-range clear voice and alerting tone announcements. The Q-6 Drive Bay Speaker comes fully assembled and ready to mount using a hanging kit or mounting bracket. Q-6 is offered in textured white.

PURVIS P/N: 315-150401-100 (Drive Bay Speaker (Soundsphere - Q6))

Vendor Part Numbers:

Drive Bay Speaker (Soundsphere - Q6)	Soundsphere	Q6
Transformer (Soundsphere - TX30)	Soundsphere	TX30
Beam Clamp for Q-6 and 110 Speakers	Soundsphere	BC
Mounting Bracket for Q-6 and 110 Speakers	Soundsphere	MBS
Drop ceiling Bracket for Q-6 and 110 Speakers	Soundsphere	DCB
Hanging Kit for Q-6, 110 and Q-8 Speakers	Soundsphere	HK
Hanging Kit Extension for Q-6, 110 and Q-8 Speakers	Soundsphere	HKEXT



Fig 1 – Soundsphere Q-6 Drive Bay Speaker

Drawing Symbol:



Technical Specifications	
Dimensions	10" W/D X 11 7/8" H
Weight	8 lbs.
Max Peak Power	70W
Max Power RMS	35W

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Device Wiring:

Device	18/2, Shielded (Plenum)
Black (Common)	Black (GND)
Blue (1W)	Red (+)

Wiring Notes: Audio input typically supplied by the ARXM-HP if zoning is required or directly from the station P/A. Refer to station Pull Schedule and wire list for wiring source.

Installation Notes:

1. The recommended height for mounting the Soundsphere Q-6 is anywhere from 12 to 36 feet.
2. Number of speakers per wire run is 2-3 maximum if tapped at 35watts.

Manufacturer's Tech Sheet:**Q-6**

Compact Weatherproof Omnidirectional Loudspeaker

**For Installations Requiring**

- Compact, full-range loudspeaker
- Clear voice announcements
- High-fidelity background and foreground music
- Fast distributed system install
- Fully weatherproof enclosure

Description

The Q-6 is SoundSphere's most compact weatherproof loudspeaker, offering omnidirectional full-range music and clear voice announcements for both indoor and outdoor installations. Broad dispersion of all frequencies is achieved with a 6.5" coaxial driver and proprietary dispersion technologies. The Q-6 offers a hemispherical coverage pattern and can evenly cover a large area with fewer speakers. It comes fully assembled and ready to mount using our hanging kit or mounting bracket.

Q-6 PRODUCT SPECIFICATIONS

System Type	6 1/2" (165 mm) coaxial
Impedance (Nominal) ¹	4 Ω
Sensitivity dB @ 2.83 V / 1 M	93 dB
Sensitivity dB @ 1 W / 1 M ²	90 dB
Frequency Response (±3 dB) ³	220 Hz - 20 kHz
Frequency Response (±10 dB) ³	70 Hz - 20 kHz
Max. Continuous Peak Power ⁴	70 W
Max. Continuous Power RMS ⁵	35 W
Max. Power SPL @ 1 M ⁶	105.5 dB
Coverage Angle (±6 dB @ 2 kHz)	175°
Coverage Angle (±6 dB @ 10 kHz)	125°
Coverage Angle (Avg. 500 Hz - 10 kHz)	175°
Transformer	Optional 30 W
Transducer: Low-Frequency Driver	6 1/2" (165 mm) polypropylene
Transducer: High-Frequency Driver	0.5" (12.7 mm) Mylar
Low-Frequency Voice Coil	1" 25.4 mm
Crossover Frequency	1500 Hz
Network Type: High Pass	First order
Enclosure & Reflector Material	Structural foam polystyrene with rust-resistant hardware
Inputs	Hardwire leads
Colors	White (paintable); custom colors available
Height	11 7/8" 302 mm
Diameter	Sphere: 10" (254 mm) Reflector: 14 7/8" (378 mm)
Weight	8 lbs 3.6 kg
Shipping Weight	11 lbs 5 kg
Packaging	One per box
Optional Accessories	30 W Line Matching Transformer (TX30), Hanging Kit (HK), 24" Hanging Kit Extension (HKEXT), Mounting Bracket (MBS), Beam Clip (BC), Drop-Ceiling Bracket (DCB), Small Screen (SS), Small Screen with Weather Filter (SWFS), Dust Filter (Q6SF)
Certifications	CE, RoHS

On-board amplification is offered with Model Q-6 Power2, making a separate amplifier unnecessary in applications where only a single wide-dispersion speaker is required for coverage.

Features

- Fully weatherproof for year-round exposure to the elements
- Hemispherical coverage pattern.
- Accurate, full-range voice announcements.
- Enhanced high-fidelity music reproduction.
- Fully assembled and ready to mount.
- Hanging or surface-mount.
- Standard white (paintable) and custom colors available.
- Available with on-board amplification (Model Q-6 Power2).

¹ Impedance listed per IEC 60268-5 with a minimum less than 80% the nominal impedance

² 1 W / 1 M sensitivity determined using nominal impedance

³ Frequency response measured in half or full space as dictated by speaker mounting configuration

⁴ Max program power is 3 dB above max continuous power

⁵ Continuous power rating, EIA-426-B test

⁶ Max output based on max continuous power

**Q-6**

Compact Weatherproof Omnidirectional Loudspeaker

Applications

Providing full-range music and voice in a compact, weatherproof enclosure, the Q-6 loudspeaker is ideal for applications such as health clubs, sports bars, restaurants, hotel lobbies, classrooms, retail stores, shopping center common areas, food courts, and outdoor applications requiring weatherproof speakers.

Patented Technologies

SoundSphere and the MSE Audio Group constantly develop new technologies which enhance audio product performance. SoundSphere innovations are protected by multiple U.S. and international patents, which explicitly cover SoundSphere's enclosure and dispersion technologies. The MSE Audio Group actively defends its patents in order to protect SoundSphere resellers and end-users.

Technical Data and Specification Tools

SoundSphere strives to provide complete and effective technical information and data to dealers, engineers and designers. All data is available from SoundSphere or at www.soundspHERE.com.

Technical data and downloads include:

- EASE™ data - 3-D polar plots
- EASE™ Address - 2-D modeling for distributed systems
- Tech Sheets - technical information and architectural specs for system engineers
- Distributed System Quick Planning Guide - online configuration tool and step-by-step guide are available to assist in the design of effective public area distributed sound systems using SoundSphere omnidirectional loudspeakers

Independent Data Acquisition and Verification

All data for SoundSphere loudspeakers is independently collected from and verified by NWAA Labs (www.nwaalabs.com) using their proprietary MACH testing system. All data is collected and analyzed according to ASTM, ISO and AES standards using EASERA, TEF and MLSSA. Full balloon data including both phase and magnitude is compiled into a variety of formats including EASE 4.x, GLL and CLF.

Architectural Specifications

The loudspeaker driver shall consist of one 6.5" (165 mm) polypropylene woofer with a 0.5" (12.7 mm) mylar dome tweeter mounted coaxially.

Performance specifications of a typical production unit shall be as follows: Usable frequency response shall extend from 70 Hz - 20 kHz (± 10 dB). The vertical polar coverage shall be $175^\circ \pm 6$ dB. Measured sensitivity (1 W / 1 M) shall be at least 90 dB. The speaker shall have a rated impedance of 4 Ω . The speaker shall be available for 25, 50, 70, and 100 V modes and shall include 7 power tap selection leads for use with electrical wire nuts or crimp caps. Rated power capacity shall be at least 35 W continuous RMS and conform to EIA-426-B testing. Calculated maximum continuous output at 1 M and shall be 105.5 dB.

The driver shall be constructed of inorganic materials that are impervious

to environmental contaminants (weather ozone, UV, chlorine, salt, etc.). The complete loudspeaker shall be no more than 11.875" (302 mm) in height. The driver shall be mounted in a spherical enclosure made of structural foam polystyrene that is no more than 10" (254 mm) in diameter. The reflector shall be no more than 14.875" (378 mm) in diameter.

The complete loudspeaker shall weigh no more than 8 lbs (3.6 kg). Hardware shall be rust and corrosion resistant.

Optional accessories shall include: a 30 W Line Matching Transformer (TX30) with taps for 25, 50, 70, and 100 V constant voltage systems; a Mounting Bracket (MBS) to mount flat against a ceiling surface; a three-element Hanging Kit (HK) for single-point suspension; a 24" Hanging Kit Extension (HKEXT); a Beam Clip (BC) for mounting to a beam flange; a Drop-Ceiling Bracket (DCB); a Small Screen (SS) to protect the speaker from foreign objects; a Small Screen with Weather Filter (SWFS) that additionally offers a water protection barrier; and a Dust Filter (Q6SF). An optional 30 W on-board amplifier (Power2) makes a separate amplifier unnecessary in applications where only a single wide-dispersion speaker is required for coverage.

The system shall be the SoundSphere Model Q-6 for wide-range, wide-coverage sound dispersion.

Warranty

SoundSphere loudspeakers are warranted against failure or malfunction due to defects in materials or workmanship for a period of five years from date of original purchase. Speaker electronics are warranted for three years. Defective units will be repaired or replaced at our option if delivered prepaid to our factory. Repaired or replaced units will be returned at our expense. Warranty does not cover appearance or damage caused by abuse, misuse, neglect, accident, or exceeding maximum rated power. Warranty does not cover labor costs involved in removing and/or reinstalling the defective unit, nor any liability due to accidents caused by improper installation. Warranty is extended to original purchaser and is not transferable.

SoundSphere®

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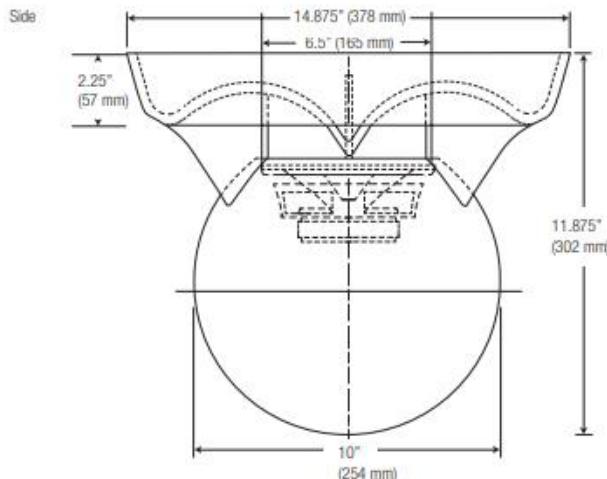
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SOUNDSPHERE
CODE SPEAKERS

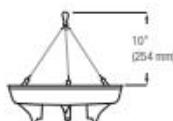
Q-6

Compact Weatherproof Omnidirectional Loudspeaker

Mechanical Drawings



Accessories



Hanging Kit (HK)



Hanging Kit Extension (HKEXT)
24" extension for use with HK.



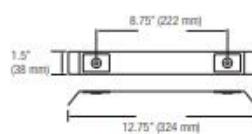
Beam Clips (BC)

Locates a 0.25" hole on a 0.125" to 0.25" beam flange using just a hammer.



Drop Ceiling Bracket (DCB)

Two twist clips and MBS are supplied. Clips twist onto t-bar stringers, and mounting bracket attaches with wing nuts.



Mounting Bracket (MBS)

For mounting speaker on a flat surface.

Line Matching Transformer (TX30)

The Model TX30 is a 30 W line matching transformer for the Model Q-6 with taps for 25, 50, 70, and 100 V constant voltage systems. The TX30 is designed for factory or field mounting in the Q-6 reflector. Connection to system wiring is via 10" color-coded flying leads. Available taps - 25 V: 30, 15, 7.5, 3.8, 1.9, 1, 0.5 W | 50 V: 30, 15, 7.5, 3.8, 1.9 W | 70 V: 30, 15, 7.5, 3.8 W | 100 V: 30, 15, 7.5 W.



Small Screen (SS)

Protects speaker driver from foreign objects.



Small Screen with Weather Filter (SWFS)

Protects from foreign objects, plus a water protection barrier.

Model Q-6 Power2 with On-Board Amplification



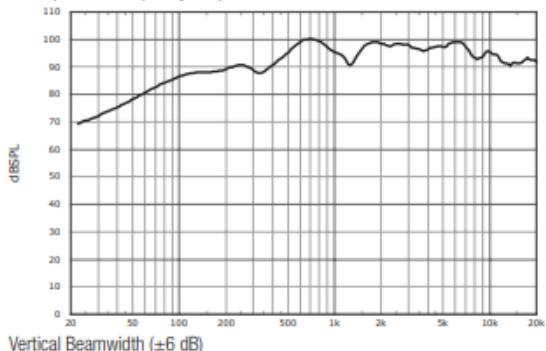
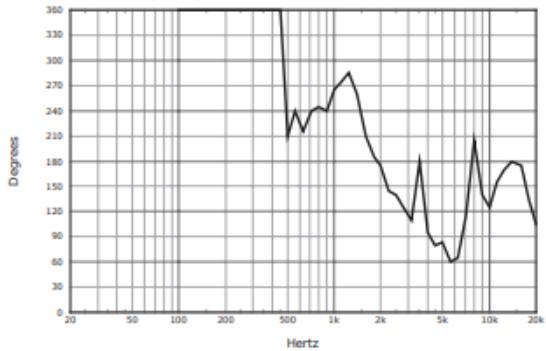
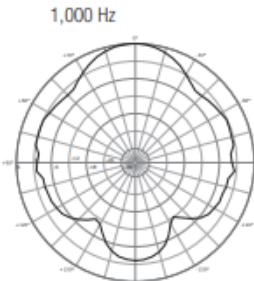
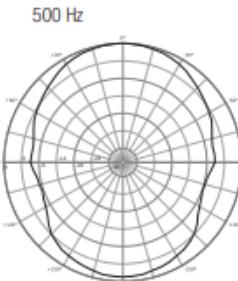
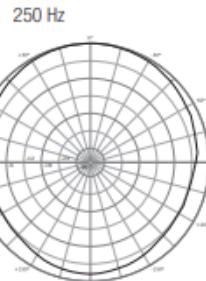
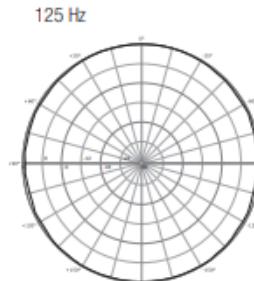
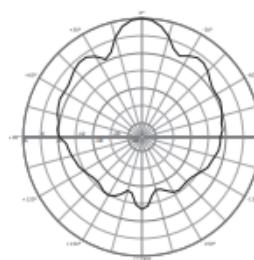
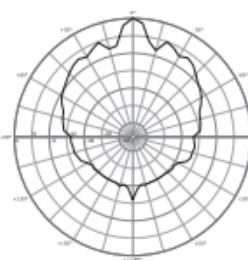
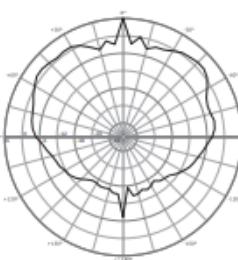
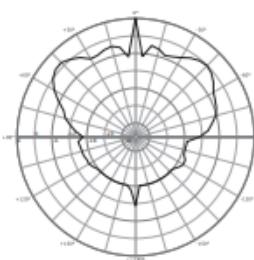
The Power2 adds on-board amplification to the compact Model Q-6 broad coverage speaker, making a separate amplifier unnecessary. Designed specifically for applications where only a single wide-dispersion speaker is required for coverage, the Power2 provides an easier and less expensive installation in such areas as small warehouses, open-ceiling classrooms, or lecture halls with video projectors, board rooms, and small retail stores.

The amplifier has been designed to mount to the rear of the reflector. Two electronically balanced inputs with level controls are provided. The Power2 amplifier also includes a master output level control.

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SOUNDSPHERE
LOUDSPEAKERS**Q-6**

Compact Weatherproof Omnidirectional Loudspeaker

Graphs**Hemispherical Frequency Response****Vertical Beamwidth (± 6 dB)****Plots (± 6 dB)****2,000 Hz****4,000 Hz****8,000 Hz****10,000 Hz**

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Manufacturer's Owner's Manual/Installation Instructions:**SOUNDSPHERE** by MSE AUDIO**OWNER'S MANUAL
SS-110 Page, SS-110B & SS-Q-6**

Please read the following instructions carefully before installing your Soundsphere® speaker. If you have any questions regarding installation that are not answered in the following directions, please contact your local sound contractor or the Soundsphere®/MSE Audio® technical support team.

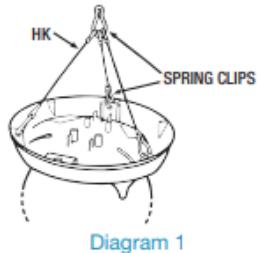
Max Power:

110B:	30 Watts RMS
Q6:	30 Watts RMS
110 Page:	60 Watts RMS

HK Hanging Kit**Hang Mounting from Above**

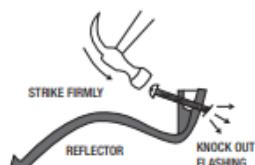
The hanging kit is attached when ordered with the speaker from the factory. If ordered separately, attach as shown in [Diagram 1](#).

- Hold the main hook above so the wires and 3 hooks will be straight as they are clipped on the speaker.
- Insert the spring clips into the bracket holes as shown. Attach the top clip to the mounting point making sure that the clips and cable are not twisted.

**Diagram 1****MBS Mounting Bracket****Preparing the Speaker**

The speaker is prepared for use with the MBS mounting bracket when both are ordered together from the factory. If ordered separately, prepare the speaker as shown in [Diagram 2](#) or [Diagram 3](#) and [Diagram 4](#).

- Begin by removing the plastic flashing from the hole in the reflector rim so that the screw can be inserted from the outside. Flashing can be removed with a 1/4" drill bit ([Diagram 2](#)), or it can easily be punched through using a hammer ([Diagram 3](#)). If using a 1/4" drill bit; be careful not to remove any material other than the flashing, or the speaker will not install correctly.
- Place the stop nut in the pocket as shown in [Diagram 4](#). Start screw through outside hole, through stop nut contained in the pocket, and slightly beyond the interior hole ([Diagram 5](#)).

**Diagram 2****Diagram 3****Diagram 4****Diagram 5****Installing the Speaker**

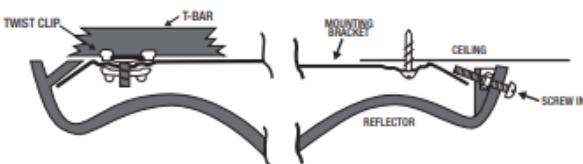
The steel bracket is pre-fastened to the ceiling or wall, then the speaker is placed on the bracket and secured in the following steps ([Diagram 6](#), [Diagram 7](#)):

- Fasten the bracket in the desired location, making sure that it is properly and safely mounted.
- Slide the side of the reflector opposite the screw over one end of the installed bracket.
- While holding the screw side against the surface, tighten the screw until the speaker is resting firmly in position.

Suspended Ceiling T-Bar Mounting

Two Caddy Twist Clips and Twist Nuts are provided for connecting to suspended ceiling T-bars. Please refer to the enclosed Caddy Clip T-bar mounting instructions for more details ([Diagram 6](#)).

- Place the clips about 8 3/4" apart on the T-bar. Check to be sure they have snapped on the bar correctly.
- Slide them into final position to fit through the holes in the mounting bracket. Tighten the thumb nuts securely.
- Secure the speaker per steps **b** and **c**, "Installing the Speaker".

**Diagram 6****Diagram 7**

TX-30 Transformer Installation Instructions

The TX-30 is designed for use with the Model 110B or Q-6 loudspeakers. Power taps are provided for 100V, 70V, and 25V systems:

	25V	70V	100V
White	30 Watts	---	---
Orange	15 Watts	---	---
Yellow	7.5 Watts	---	---
Brown	3.8 Watts	30 Watts	---
Blue	1.9 Watts	15 Watts	30 Watts
Violet	0.9 Watts	7.5 Watts	15 Watts
Green	0.5 Watts	3.8 Watts	7.5 Watts
Black	Common	Common	Common

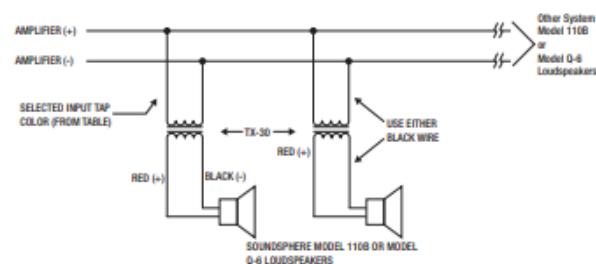
Remember to clip and insulate unused input wires; shorting any input wire to another will reduce the volume level and place an unexpected load on the power amplifier.

When ordered with the Model 110B or Q-6, the TX-30 is mounted to the back of the reflector and the loudspeaker driver connections are made at the factory.

Use either black wire for input common or driver (-) connections.

Notes:

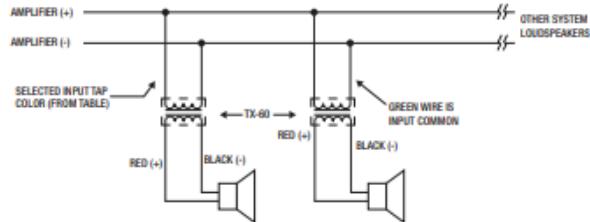
- Red or Red with White stripe is 4 ohm tap.
- The total tap wattages should not exceed the amplifier's capability.



TX-60 Transformer Installation Instructions

The TX-60 is designed for use with the Model 110 Page loudspeaker. Power taps are provided for 70V and 100V systems:

	70V	100V
Orange	60 Watts	---
Yellow	30 Watts	60 Watts
White	15 Watts	30 Watts
Green	Common	Common



Remember to clip and insulate unused input wires; shorting any input wire to another will reduce the volume level and place an unexpected load on the power amplifier.

Notes:

- Red or Red with White stripe is 4 ohm tap.
- The total tap wattages should not exceed the amplifier's capability.

OWNER'S MANUAL**SS-110 Page, SS-110B & SS-Q-6****Warranty**

Soundsphere loudspeakers carry a 5 year limited warranty and a 3 year limited warranty on all electrical components. See warranty sheet for details and limitations.

Replacement Parts

110B	6.5" Dual cone, wide range, 30 Watt	Order Model Number FR-6
Q-6	6.5" 30 Watt full range coaxial loudspeaker driver with crossover	Order Model Number CX-6
110 Page	6.5" high output, voice-only, 60 Watt	Order Model Number ITP-6

Other Information

Wire runs between the amplifier(s) and loudspeaker(s) must be of the appropriate gauge to insure the full audio performance capabilities of the Soundsphere loudspeakers. This applies to all loudspeaker impedances (4 or 8 Ohms) or audio line voltages (50, 70.7 or 100 Volts). For more information, please see the "Downloads" section at www.soundsphere.com, or call our Customer Service at 913.663.5600.

Always check local requirements for overhead suspension of loudspeakers.

WARNING

Be sure to securely tighten all hardware before hanging the loudspeaker. Wire rope (steel cable), cable clamps with saddles and thimbles of suitable size and strength are the recommended materials for overhead suspensions. All loudspeakers should be redundantly safety wired to structural members of the building with an approved safety wire system or other agency certified materials.

IMPORTANT: Always check local safety codes before installing any overhead loudspeaker system and for periodic inspection and maintenance of the installation.

PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:
PURVIS Systems
88 Silva Lane
Middletown RI 02842
401.849.4750 / Fax 401.849.0121

**MicroTouch Remote Touch
Screen (RTS) Monitor
Installation Cutsheet (CS 050)**

Revision 1

February 29, 2024

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MicroTouch Remote Touch Screen (RTS) Monitor

The MicroTouch Remote Touch Screen (RTS) Monitor Model DT-215P-A1 (Fig 1 and Fig 2) is a 22-inch, open-frame, wall mounted touch monitor that displays the Station Control Unit (SCU) application and allows worksite personnel to interact with the system. The touch screen is a ruggedized device designed for commercial applications, such as photo kiosks, gaming, and guest/hospitality environments.

PURVIS P/N: 315-250005-131 (RTS)

PURVIS P/N: 315-190302-131 (RTS Mounting Bracket)

PURVIS P/N: 315-250300-131 (VGA Video Extender)

PURVIS P/N: 315-250101-131 (VGA VESA Bracket)

PURVIS P/N: 315-250200-131 (USB 150' Extender)

PURVIS P/N: 315-250201-131 (USB 300' Extender)

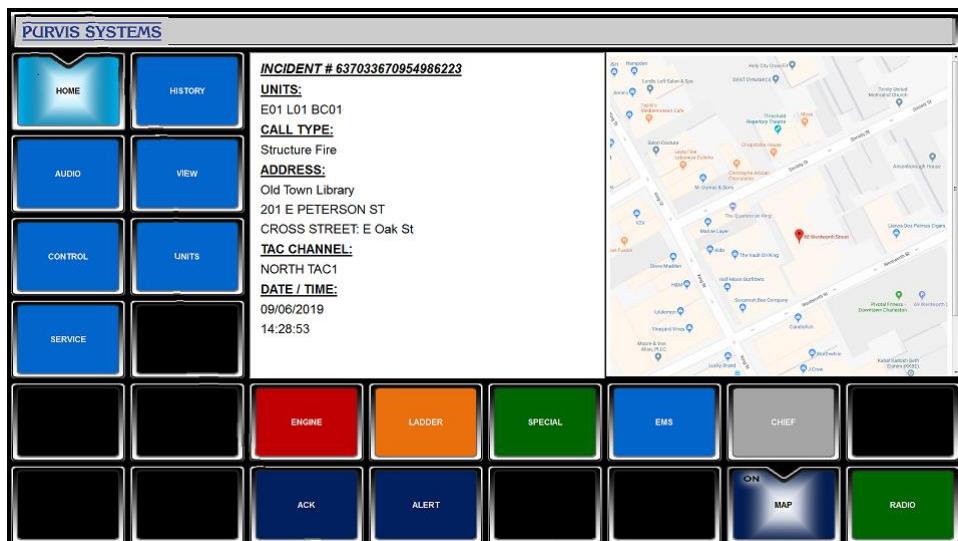
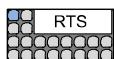


Fig 1 – MicroTouch RTS Monitor



Fig 2 – MicroTouch RTS Monitor Hardware



Drawing Symbol:

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Technical Specifications (Model DT-215P-A1)	
Dimensions	20.12" W x 6.81" D x 12.69" H
Weight	12.39 lbs. (no Video Hub mounted)
Voltage	100-240VAC at 20-24W

Device Wiring:**110 VAC**

<i>Standard</i>	<i>110VAC</i>
CAT5/6- RJ45 Terminated (568B)	
RJ45 Pin #	CAT5/6 Color Code
1	White/Orange
2	Orange
3	White/Green
4	Blue
5	White/Blue
6	Green
7	White/Brown
8	Brown
Wiring Notes: Requires AC power source for both the RTS and VGA receiver module, while the 150' USB extender (Note: 300' extender requires AC power source) is powered by the USB bus. Requires a CAT5e Network connection (300' max length) between the VGA extender (local unit) located on the SCU and the remote unit which is mounted to the RTS.	

Mounting:

- RTS can be placed on desk with stand (Fig 3), or wall mounted.
- Requires that a 120VAC receptacle box be mounted near the RTS (preferably behind it) to provide power to both the monitor and VGA receiver, as well as a Network box for the video extension.
- VGA receiver module can be mounted to the back of the monitor using the VESA bracket listed above.
- Can be mounted using the RTS Mounting Bracket listed above (see mounting bracket installation instructions starting on page 6).



Fig 4 – MicroTouch RTS with Stand

RTS Monitor Manufacturer's Specs Sheet:



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Item	Category	Specifications
LCD Panel	Size	21.5" TFT LCD
	Resolution	1920 x 1080
	Brightness (typical)	225 cd/m ²
	Contrast Ratio (typical)	1000:1
	Number of Colors	16.7 million
	Viewing Angle (typical)	Horizontal: 178 degrees; Vertical: 178 degrees
Touch Screen	Touch Type	P-CAP
	Simultaneous touch points	Up to 10
Video	Type	DisplayPort 1.2a HDMI 1.3 (Compatible with HDMI 1.4) VGA USB Type C (via Alt Mode for DP video support)
Power	AC Adapter Input	AC 100V - 240V (50/60Hz), 60W max
	AC Adapter Output	12VDC, 5A max
	Monitor On	20W typical, 24W max (1.25A typ, 2A max)
	Power Saving	Sleep mode: ≤ 1W; Off: ≤ 0.5W
Size and Weight	Dimensions (W x H x D) Without stand	510.96 mm x 308.01 mm x 37.9 mm 20.12 in x 12.13 in x 1.49 in
	Dimensions (W x H x D) With IS-156-A1 Stand	510.96 mm x 322.28 mm x 172.98 mm 20.12 in x 12.69 in x 6.81 in
	Net Weight	4.05 kg without stand, 5.62 kg with IS-215-A1 stand 8.93 lb without stand, 12.39 lb with IS-215-A1 stand
	VESA Mount	100 mm x 100 mm
	Compliance	CE, FCC, LVD, RoHS
	Operating Temperature	0°C - 40°C
Environment	Storage Temperature	-20°C - 60°C
	Operating Humidity	20% - 90% RH, non-condensing

VGA Video/Audio Extender Manufacturer's Specs Sheet:**VGA Video/Audio Extender via CAT5: Extend to 300 Feet**

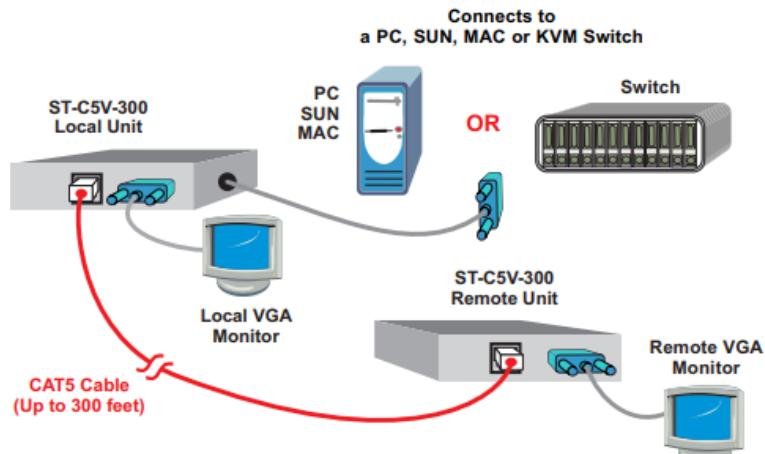
XTENDEX®

Extend a VGA monitor up to 300 feet away from a computer.

- Ideal solution for digital signage applications.
- Supports local and remote VGA monitors.
- Supports resolutions to 1920x1440.
- Sharpest and clearest VGA quality over CAT5 of any manufacturer.
- Built-in surge protection.
- Available with optional stereo audio.
- Integrated mounting brackets for easy surface/wall mounting.
- Use in-house CAT5/5e/6/6a phone wiring to locate a monitor remotely.
- Optional VESA mounting bracket is available for mounting the local or remote unit to the back of a flat panel monitor.



The XTENDEX® VGA Extender transmits VGA video up to 300 feet away from a computer using CAT5/5e/6/6a cable. Each video extender consists of a local unit that connects to a computer and also supplies video to a local monitor, and a remote unit that connects to a monitor.

Configuration and Cable Illustration

VGA Video/Audio Extender via CAT5: Extend to 300 Feet

XTENDEX®

Extend a VGA monitor up to 300 feet away from a computer.

Specifications

Local Unit

- **Host Connection**
 - Supports a PC, SUN, MAC or NTI switch with VGA video.
 - Multiplatform support: Windows 7/8/10, Windows Server 2008/2012/2016/2019, Solaris, Linux, FreeBSD, and MAC OS 10/11.
 - Male 15-pin HD connector for computer connection.
 - Optional stereo audio support - 3.5 mm stereo plug.
- **Local Access**
 - Crisp and clear 1920x1440 video resolution.
 - Female 15-pin HD connector for local VGA monitor.
 - Optional stereo audio support - 3.5 mm stereo jack.

Remote Unit

- Supports resolutions up to 1920x1440; refer to the resolution chart below for resolutions at different lengths.
- Female 15-pin HD connector.
- Optional 3.5 mm stereo audio connection.

Video Quality Adjustment

- Video quality adjustment for different lengths of CAT5/5e/6/6a cable is done manually.
- Test Pattern for Cable Length

Environmental

- Operating temperature: 32 to 100°F (0 to 38°C).
- Storage temperature: -22 to 140°F (-30 to 60°C).
- Operating and storage relative humidity: 5 to 90% non-condensing RH.

Dimensions

- WxDxH: 3.5x3.1x1.2 in (89x79x30 mm)
- Weight: 1.2 lbs (0.54 kg)

Distances and Resolutions for CAT5/Cat5e and CAT6 Cables		
Cable	Distance ft	Maximum Resolution
CAT5/5E Solid UTP	300	1280x1024 at 60 Hz
	150	1600x1200 at 60 Hz
	100	1920x1440 at 60 Hz
CAT5/5E SOLID STP, CAT6 Solid UTP	300	1600x1200 at 60 Hz
	150	1280x1024 at 60 Hz
	100	1600x1200 at 60 Hz
CAT6a Solid UTP	300	1024x768 at 60 Hz
	150	1280x1024 at 60 Hz
	100	1920x1200 at 60 Hz

Note: CAT6/6a cable has a higher skew than CAT5/5e cable, which causes colors to smear. Since these extenders do not have internal skew compensation, they work at shorter distances with CAT6/6a cable.

VGA Extender Models			
Supported Features	Local or Remote	# of Ports	NTI Part #
VGA	Both	1	ST-C5V-300
VGA + Audio	Both	1	ST-C5VA-300



1.800.RGB.TECH (800.742.8324)
Toll Free: US & Canada

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330.562.7070
International calls
330.562.1999
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www.networktechinc.com

2



ST-C5MK-VESA - VESA Mounting Bracket

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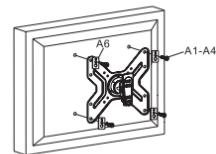
Mounting Bracket Installation Instructions:

DISPLAYS2GO



STEP2-A

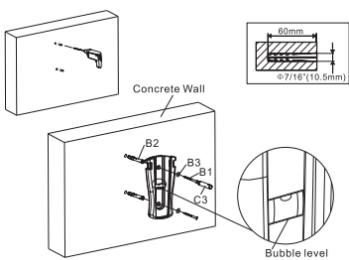
[EN] Attaching the VESA plate to the monitor



For TVs with a flat back

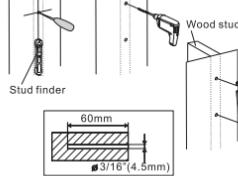
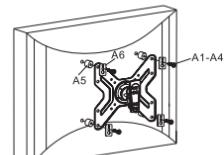
STEP1-A

[EN] Solid concrete mounting



STEP2-B

[EN] For TVs with a curved back or obstruction

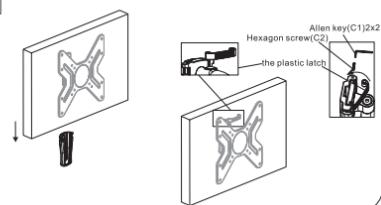


STEP1-B

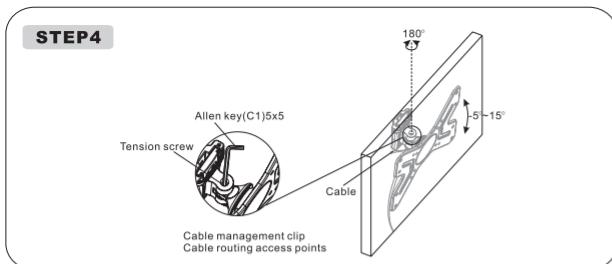
[EN] Wood Stud Mounting

STEP3

[EN] Hang the TV onto the wall plate



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PURVIS SYSTEMS

Fire Station Alerting System



Prepared By:
PURVIS Systems
88 Silva Lane
Middletown RI 02842
401.849.4750 / Fax 401.849.0121

Purvis Red Light, Ramp and
Strobe for Interior Installation
Cutsheet (CS ???)

Revision 1

September 23, 2025

Red Strobe Lights

Purvis strobe lights (Figures 1 & 2) are typically used in apparatus bays, work rooms, gyms or other locations where audio alerts are difficult to hear.

PURVIS P/N: 315-260012-131-S (Red Strobe Light, Interior)

PURVIS P/N: 315-260012-131-R (Red Ramp Light, Interior)

PURVIS P/N: 315-260012-131 (Red Light, Interior)



Fig 1 – Red Strobe



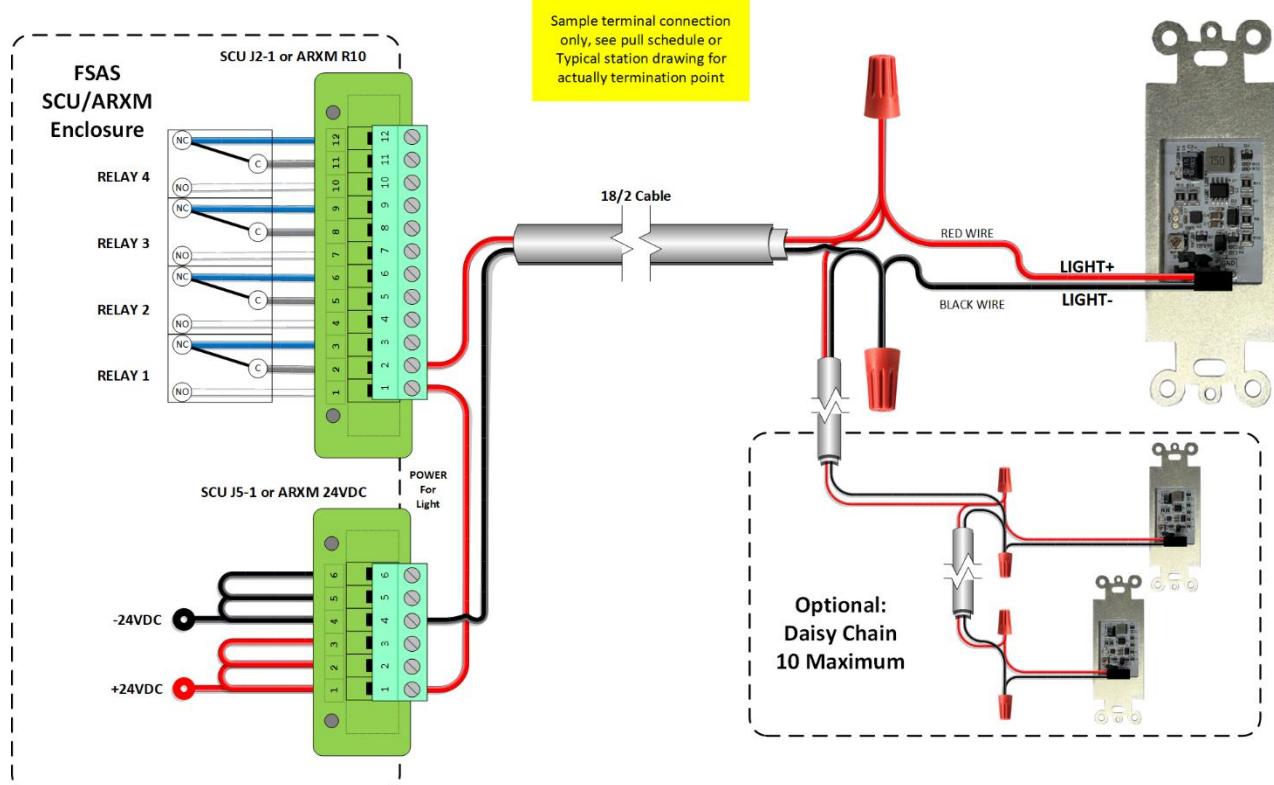
Fig 2 – Purvis Red Strobe fits in a standard single gang back box

Drawing Symbols:



Device Wiring (24VDC):

18/2 Plenum	
Colored Wire = +24VDC	Red
Black = Ground	Black
Wiring Notes: Requires 18/2 plenum rated cable from the Station Control Unit, Relay Expansion Module or Audio Relay Expansion Module (SCU, RXM or ARXM). Can be daisy chained up to 10 lights (Fig 4).	



Mounting:

- Purvis lights are ceiling or wall mounted (Fig 5) via a Single Gang Box.



Fig 5 – Ceiling Mounted

PURVIS SYSTEMS

Fire Station Alerting System (FSAS)



Prepared By:
PURVIS Systems
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**Rack Mount (Rev B) Station
Control Unit (SCU)
Installation Document (ID 007)**
315-030004-131/134 and
315-030005-131/134

Revision 1.05

August 11, 2023

CHANGE PAGES

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PURVIS SYSTEMS

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PURVIS SYSTEMS

1 INTRODUCTION

The 3U 19" rack mounted Station Control Unit (SCU) is installed in each fire station and is responsible for receiving the incidents (or alerts) and then activating/updating all of the appropriate station electronics. Additionally, the SCU is responsible for playing tones and messages over the station speakers. The SCU provides the core functionality of the PURVIS FSAS in each station and can be configured to audio and lighting zones based on hours of operation (day/night), incident type and the apparatus (units) being dispatched.

An example of this operation is that speaker zones in the Rescue areas would not need to be activated during a Fire-specific dispatch. Additionally, based on the hours of operation (typically during night hours), the SCU can be configured to lower the volume levels on specific zones. Lowering the audio levels at night when there is less background noise can help reduce stress levels of response personnel.

PURVIS part numbers include the following:

- PURVIS P/N:** 315-030004-131-NN
- PURVIS P/N:** 315-030004-134 (Spares Kit)
- PURVIS P/N:** 315-030005-131-NN
- PURVIS P/N:** 315-030005-134 (Spares Kit)

2 DESCRIPTION

The SCU provides multiple audio inputs, audio outputs and dry contact relay contacts as detailed below. All inputs and outputs are available on the rear panel. Technical specifications are provided in **Table 1**.

Table 1 - Technical Specifications

Technical Specifications	
Dimensions	5.2" x 18.0" x 17.3" (132 x 458 x 440 mm)
Weight	32.00 lbs (14.52 kg)
Power Requirements	120 VAC @ 600 Watts
Operating Temperature	0 to +50°C / 32 to 122°F
Maximum Temperature	-20 to +60°C / -4 to 140°F
Audio Inputs	Three (3) unbalanced line level inputs. One (1) balanced line level based on jumper configuration. One (1) Can be 25, 70, or 100v.
Audio Outputs	Two (2) balance and unbalanced line levels. Output 1: Unbalance line level output. Output 2: Balance line level output.
Relay Outputs	Eight (8) 10 Amp @ 250VAC / 8 Amp @ 30VDC relays, normally open and normally closed contacts available for each relay.

General Purpose Inputs	24 contact closure inputs used to monitor various station inputs or to support external) switches such as individual zone acknowledgement switches. A +5VDC source through a pull-up resistor on the positive input shorted to the ground input indicates an activation.
Microphone Input	Two (2) connectors are provided for connecting a microphone, an XLR connector on the front panel and terminals on the rear panel.
Internal Analog Inputs	Six (6) internal analog inputs currently only used to monitor manual activation in conjunction with a contact closure input. A +5VDC source through a pull-up resistor on the positive input shorted to the ground input indicates a full activation. However, apply a resistive value across the input allows a single input to represent values from 0 to 255.
VGA Output	One (1) VGA connector is provided for connection to a remote display/touch screen.
HDMI Output	The SCU generates FSAS incident information, as well as system status, using HDMI video extension over Ethernet. It is outputted from the local-area network (LAN) 4 port, but can be extended to as many message boards (MSB) as needed provided an HDMI receiver at each MSB is connected to the system LAN.
DC Voltage Outputs	Three (3) connectors are available to provide 5VDC, 12 VDC, and 24 VDC for external devices that require DC voltage.
USB Ports	Five (5) (2 front/3 rear) mounted USB ports are provided for connection to a remote touch screen, keyboard or mouse.
Ethernet	Four (4) Ethernet connectors are provided on the rear panel for connection to a LAN switch, these are required for proper SCU operation. Two (2) Ethernet connectors are provided on the rear panel for connection to a customer wide-area network (WAN) for communication to the central servers.

3 FRONT PANEL CONNECTORS AND CONTROLS

SCU front panel connectors and controls are displayed in **Figure 1**.

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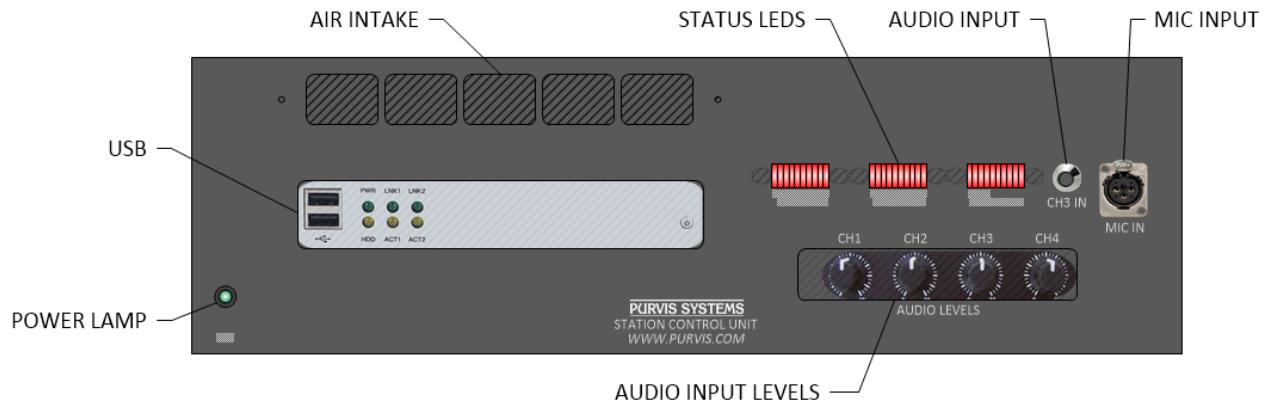


Figure 1 - SCU Front Panel

4 REAR PANEL CONNECTORS AND CONTROLS

SCU rear panel connectors and controls are displayed in **Figure 2**.

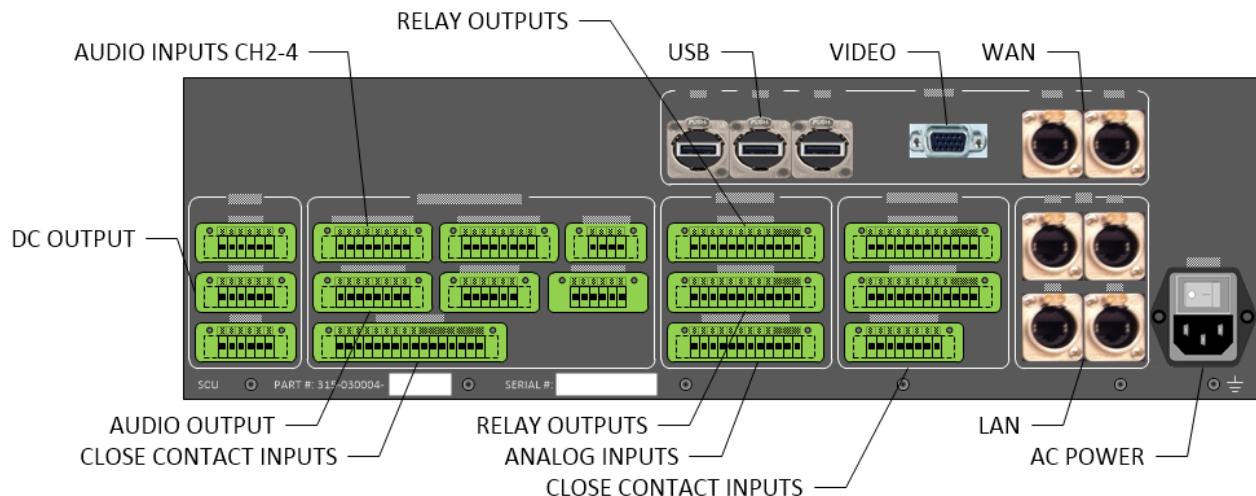


Figure 2 - SCU Rear Panel

5 CONNECTOR PINOUTS

SCU connector pinouts are provided in **Table 2**.

Table 2 – SCU Connector Pinouts

J1-1 UNBAL AUDIO INPUT	
Unbalanced Audio Input Channels 2-4.	
Pins	Description

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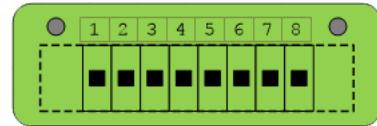
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1	*Input CH1 Signal + Reserved for SCU Audio
2	*Input CH1 Signal GND - Reserved for SCU Audio
3	Input CH2 Signal +
4	Input CH2 Signal GND -
5	Input CH3 Signal + Also available on front panel
6	Input CH3 Signal GND - see front panel
7	Input CH4 Signal +
8	Input CH4 Signal GND -

J1-2 CHx to OUT on FAULT

Place jumper between pins to route audio to the output.

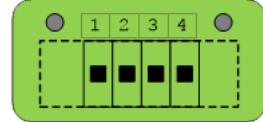
Pins	Description
1	Channel 1 Audio Jumper 1 to 5
2	Channel 2 Audio Jumper 2 to 6
3	Channel 3 Audio Jumper 3 to 7
4	Channel 4 Audio Jumper 4 to 8
5	Channel 1 Audio Jumper 1 to 5
6	Channel 2 Audio Jumper 2 to 6
7	Channel 3 Audio Jumper 3 to 7
8	Channel 4 Audio Jumper 4 to 8



J1-3 25/70/100

Matches a 100, 70 or 25 volt speaker line to any unbalanced line-level audio input. 100, 70, or 25 volt speaker line is wired to pins 3 and 4. The unbalanced output would be wired to an appropriate J1 input.

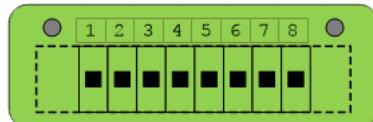
Pins	Description
1	Output Unbalanced Signal +
2	Output Unbalanced Signal -
3	Input Speaker Line +
4	Input Speaker Line -



J1-4 Audio out

Pins 1 and 5, unbalanced signal output is typically field wired to self-amplified speakers, FSAS AXM, or amplifier.

Pins	Description
1	Output Switched Unbalanced Signal +
2	NA
3	Output Switched Balanced Signal +
4	Output Always Active Unbalanced Signal +
5	Output Switched Unbalanced -
6	Output Switch Balanced -



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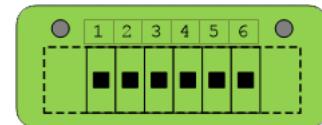
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7	Output Balanced Shield GND	
8	Output Always Active Unbalanced -	

J1-5 BAL IN

**Converts a balanced signal to unbalanced signal.
Balanced signal would be wired to pins 4, 5 and 6. The unbalanced output would be wired to an appropriate J1 input.**

Pins	Description
1	Output Unbalanced Signal +
2	Output Unbalanced Signal -
3	NA
4	Input Balanced MIC +
5	Input Balanced MIC -
6	Input Balanced MIC Shield



J1-6 MIC IN/OUT*

Balanced Microphone Input for paging microphone.

Pins	Description
1	Input Balanced MIC Shield
2	Input Balanced MIC +
3	Input Balanced MIC -
4	Input Balanced MIC Shield
5	Output Unbalanced MIC +
6	Output Unbalanced MIC -

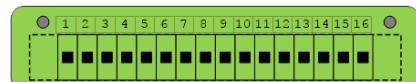


*Note: The MIC input is also available via the front panel XLR Connector.

J1-7 Close Contact Inputs 1-8

Close Contact Inputs for monitoring dry contact inputs.

Pins	Description
1	Input #1 Close Contact (5VDC) +
2	Input #1 Close Contact (GND) -
3	Input #2 Close Contact (5VDC) +
4	Input #2 Close Contact (GND) -
5	Input #3 Close Contact (5VDC) +
6	Input #3 Close Contact (GND) -
7	Input #4 Close Contact (5VDC) +
8	Input #4 Close Contact (GND) -
9	Input #5 Close Contact (5VDC) +
10	Input #5 Close Contact (GND) -
11	Input #6 Close Contact (5VDC) +
12	Input #6 Close Contact (GND) -
13	Input #7 Close Contact (5VDC) +

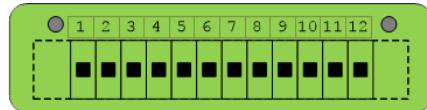


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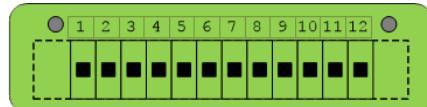
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14	Input #7 Close Contact (GND) -	
15	Input #8 Close Contact (5VDC) +	
16	Input #8 Close Contact (GND) -	

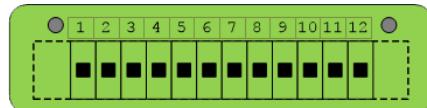
J2-1 Relay Outputs 1-4	
General Purpose relay outputs providing both Normally Open and Normally Closed contacts.	
Pins	Description
1	Output Relay 1 NC Contact
2	Output Relay 1 Common
3	Output Relay 1 NO Contact
4	Output Relay 2 NC Contact
5	Output Relay 2 Common
6	Output Relay 2 NO Contact
7	Output Relay 3 NC Contact
8	Output Relay 3 Common
9	Output Relay 3 NO Contact
10	Output Relay 4 NC Contact
11	Output Relay 4 Common
12	Output Relay 4 NO Contact



J2-2 Relay Outputs 5-8	
General Purpose relay outputs providing both Normally Open and Normally Closed contacts.	
Pins	Description
1	Output Relay 5 NC Contact
2	Output Relay 5 Common
3	Output Relay 5 NO Contact
4	Output Relay 6 NC Contact
5	Output Relay 6 Common
6	Output Relay 6 NO Contact
7	Output Relay 7 NC Contact
8	Output Relay 7 Common
9	Output Relay 7 NO Contact
10	Output Relay 8 NC Contact
11	Output Relay 8 Common
12	Output Relay 8 NO Contact



J2-3 Analog Inputs 1-6	
Analog Inputs – Currently used for manual activation operations only.	
Pins	Description
1	Input #1 Analog (5VDC) +
2	Input #1 Analog (GND) -
3	Input #2 Analog (5VDC) +



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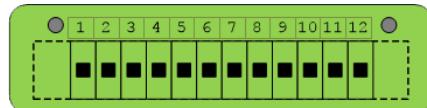
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4	Input #2 Analog (GND) -
5	Input #3 Analog (5VDC) +
6	Input #3 Analog (GND) -
7	Input #4 Analog (5VDC) +
8	Input #4 Analog (GND) -
9	Input #5 Analog (5VDC) +
10	Input #5 Analog (GND) -
11	Input #6 Analog (5VDC) +
12	Input #6 Analog (GND) -

J3-1 Close Contact Inputs 9-14

Close Contact Inputs for monitoring dry contact inputs.

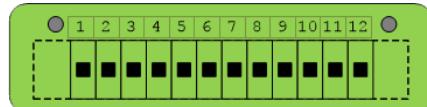
Pins	Description
1	Input #9 Close Contact (5VDC) +
2	Input #9 Close Contact (GND) -
3	Input #10 Close Contact (5VDC) +
4	Input #10 Close Contact (GND) -
5	Input #11 Close Contact (5VDC) +
6	Input #11 Close Contact (GND) -
7	Input #12 Close Contact (5VDC) +
8	Input #12 Close Contact (GND) -
9	Input #13 Close Contact (5VDC) +
10	Input #13 Close Contact (GND) -
11	Input #14 Close Contact (5VDC) +
12	Input #14 Close Contact (GND) -



J3-2 Close Contact Inputs 15-20

Close Contact Inputs for monitoring dry contact inputs.

Pins	Description
1	Input #15 Close Contact (5VDC) +
2	Input #15 Close Contact (GND) -
3	Input #16 Close Contact (5VDC) +
4	Input #16 Close Contact (GND) -
5	Input #17 Close Contact (5VDC) +
6	Input #17 Close Contact (GND) -
7	Input #18 Close Contact (5VDC) +
8	Input #18 Close Contact (GND) -
9	Input #19 Close Contact (5VDC) +
10	Input #19 Close Contact (GND) -
11	Input #20 Close Contact (5VDC) +
12	Input #20 Close Contact (GND) -

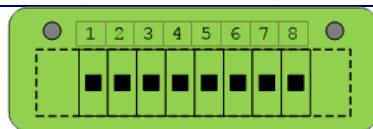


J3-3 Close Contact Inputs 21-24

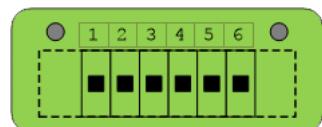
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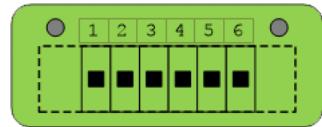
Close Contact Inputs for monitoring dry contact inputs.	
Pins	Description
1	Input #21 Close Contact (5VDC) +
2	Input #21 Close Contact (GND) -
3	Input #22 Close Contact (5VDC) +
4	Input #22 Close Contact (GND) -
5	Input #23 Close Contact (5VDC) +
6	Input #23 Close Contact (GND) -
7	Input #24 Close Contact (5VDC) +
8	Input #24 Close Contact (GND) -



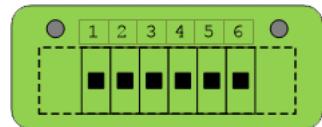
J5-1 24VDC	
24VDC output for external devices requiring power, max power available 7.5 Amps @ 24VDC, 150 Watts.	
Pins	Description
1	+24VDC
2	+24VDC
3	+24VDC
4	GND
5	GND
6	GND



J5-2 12VDC	
12VDC output for external devices requiring power, max power available 15 Amps @ 12VDC, 150 Watts.	
Pins	Description
1	+12VDC
2	+12VDC
3	+12VDC
4	GND
5	GND
6	GND



J5-3 5VDC	
5VDC output for external devices requiring power, max power available 25 Amps @ 5VDC, 125 Watts.	
Pins	Description
1	+5VDC
2	+5VDC
3	+5VDC
4	GND
5	GND
6	GND



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ETH1, ETH2, ETH3, ETH4, WAN1, WAN2	
Ethernet Connectors	
Pins	Description
1	TX+(WHT/ORG)
2	TX-(ORG)
3	RX+(WHT/GRN)
4	TRD2+(BLU)
5	TRD2-((WHT/BLU)
6	RX-(GRN)
7	TRD3+(WHT/BRN)
8	TRD3-(BRN)

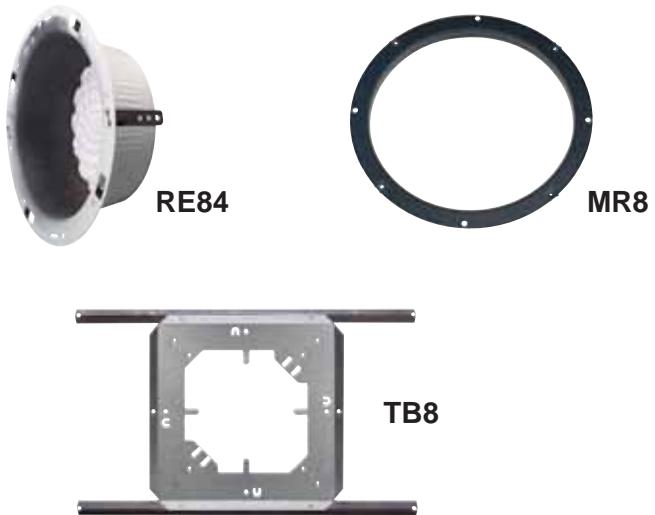


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PURVIS SYSTEMS

Mounting Accessories for Ceiling Speaker Grille Assemblies*

Models RE84, MR8, TB8



Description The RE84 Ceiling Speaker Enclosure is a protective enclosure for an 8" speaker, designed for recessed installations, and for use with any of the Bogen ceiling grilles. One-piece steel construction includes a mounting ring and a foam insert to reduce metallic resonance. The RE84 is finished in rust-resistant primer and is tapered for easy stacking. UL approved.

The MR8 Mounting Ring is a cold-rolled steel unit which will mount any of the Bogen ceiling grilles, for installations where the RE84 is not used.

The TB8 Tile Bridge is a load-bearing T-bar support designed to sustain the weight of an 8" speaker, grille and protective enclosure in suspended ceiling construction. Use of the TB8 improves environmental safety and eliminates unsightly sag in 2'-by-2' and 2'-by-4' acoustic ceiling tiles.

Features

RE84 - Ceiling Speaker Enclosure

- Protective enclosure for 8" speaker in recessed installations
- One-piece steel construction includes mounting ring and foam insert to reduce metallic resonance
- Finished in rust-resistant primer
- For use with any Bogen ceiling grille or assembly
- UL approved

MR8 - Mounting Ring

- Constructed of cold-rolled steel
- Finished in rust-resistant primer
- For use with any Bogen ceiling grille or assembly

TB8 - Tile Bridge

- Load-bearing T-support
- Capable of sustaining weight of any Bogen 8" ceiling speaker, grille, and enclosure in suspended ceiling installations
- Steel construction
- Finished in rust-resistant coating

Architect and Engineer Specifications

RE84 - Ceiling Speaker Enclosure The protective enclosure for the 8" cone-type loudspeakers shall be a Bogen model RE84, or equivalent, designed for recessed installations. It shall be constructed of one-piece heavy-gauge steel, and shall include a speaker mounting ring. A foam insert shall be permanently attached to the inner surface, to prevent metallic resonance. Four combination 1/2" – 3/4" conduit knockouts shall be provided at 90 degree intervals, and the unit shall be finished in a rust-resistant primer coating. The dimensions shall be: 12-1/4" dia. x 4-1/2" D.

MR8 - Mounting Ring The plaster ring shall be a Bogen model MR8, or equivalent, circular cold-rolled steel unit that will mount any Bogen ceiling grille. It shall be finished in a rust-resistant primer coating, and the dimensions shall be: 12" dia. x 3/4" D.

TB8 - Tile Bridge The load-bearing T-bar support shall be a Bogen model TB8, or equivalent, capable of sustaining the weight of an 8" speaker, grille and protective enclosure in suspended ceiling construction. It shall be manufactured of steel and shall be finished with a rust-resistant galvanized coating. The unit shall measure: 23-3/4" W x 3/4" H x 14-1/2" D.

* For speakers mounted to CG8AW, PG8A, PG8U, PG8W, and SG8W



Specifications subject to change without notice.

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54-7777-10B 1108