PROJECT MANUAL FOR:

Molecular Bioscience Building Renovations & Maintenance

MONTANA STATE UNIVERSITY
BOZEMAN, MONTANA

August 11, 2026

PPA No. 22-0045

MONTANA STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT
BOZEMAN, MONTANA
PHONE: (406) 994-5413 FAX: (406) 994-5665

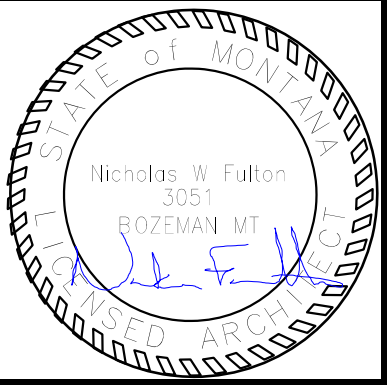


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MONTANA STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT

Sixth Avenue and Grant Street • P.O. Box 172760 • Bozeman, Montana
59717-2760 Phone: (406) 994-5413 • Fax: (406) 994-5665

PERMIT NOTICE

(Form Revision Date: January 2026)

The permit application for this project has been submitted to the Montana Department of Labor & Industry (DOLI) for review via the portal:

https://bsd.dli.mt.gov/building-codes-permits/permit-applications/building-permits/

The owner shall pay for plan review fees and building permit fees required for this project.

The building permit must be appropriately displayed at the project site before construction may begin.

Electrical and Plumbing contractors will need to secure their specific permits. Information can be found here:

https://bsd.dli.mt.gov/building-codes-permits/

MONTANA
STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT
516 W. Grant Street
P.O. Box 172760 • Bozeman, Montana 59717-2760
Phone: (406) 994-5413 • Fax: (406) 994-5665

INVITATION TO BID

Sealed bids will be received until **2:00 PM** on **Tuesday, September 1, 2026,** and will be publicly opened and read aloud in the offices of **MSU University Facilities Management, Plew Building, 516 W. Grant St., Bozeman, Montana**, for: **Molecular Bioscience Building Renovations & Maintenance, PPA No. 22-0045.**

Bids shall be submitted on the form provided within the Contract Documents. Contract documents may be obtained at the offices of:

Montana State University
UNIVERSITY FACILITIES MANAGEMENT
Plew Building, 516 W. Grant St.
PO Box 172760
Bozeman, Montana 59717-2760

On the web at:
http://www.montana.edu/pdc/bids.html

A PRE-BID WALK-THROUGH IS SCHEDULED FOR Monday, August 17, 2026, AT 10:00 a.m. PARTICIPANTS SHOULD MEET AT MAIN ENTRANCE OF THE MB BUILDING. ATTENDANCE IS STRONGLY RECOMMENDED. QUESTIONS RECEIVED AFTER AUGUST 25, 2026, WILL BE RESPONDED TO AT THE OWNER'S DISCRETION. Bidders should thoroughly review the contract documents before the pre-bid conference.

Bids equal to or greater than $150,000 must be accompanied by a bid security meeting the requirements of the State of Montana in the amount of 10% of the total bid. After award, the successful bidder must furnish an approved Performance Security and a Labor & Material Payment Security each in the amount of 100% of the contract for contracts equal to or greater than $150,000.

No bidder may withdraw his bid for at least thirty (30) calendar days after the scheduled time for receipt of bids except as noted in the Instructions to Bidders.

The Owner reserves the right to reject any or all bids and to waive any and all irregularities or informalities and the right to determine what constitutes any and all irregularities or informalities.

Time of Completion
Bidder agrees to commence work after receipt of the Contract for Construction, on the specified date of commencement**, October 1, 2026**, and to substantially complete the project by **April 3, 2028**.

The State of Montana makes reasonable accommodations for any known disability that may interfere with an applicant's ability to compete in the bidding and/or selection process. In order for the state to make such accommodations, applicants must make known any needed accommodation to the individual project managers or agency contacts listed in the contract documents.

State of Montana - Montana State University

MONTANA STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT
Sixth Avenue and Grant Street
PO Box 172760 • Bozeman, Montana 59717-2760
Phone: (406) 994-5413 • Fax: (406) 994-5665

INSTRUCTIONS TO BIDDERS

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Provided in the Printed Project Manual:
Invitation to Bid
Instruction to Bidders
Bid Proposal, Form 098
Sample Standard Form of Contract
State of Montana General Conditions
MSU Supplementary Conditions
Specifications
Drawings

These additional forms can be found on our website or will be provided upon request:
http://www.montana.edu/pdc/docs/index.html
Substitution Request, Form 99
Schedule of Values, Form 100
Periodic Estimate for Partial Payment, Form 101
Acknowledgement of Subcontractors, Form 102
Consent of Surety to Final Payment, Form 103
Contract Change Order, Form 104
Contractor's Affidavit, Form 106
Certificate of Substantial Completion, Form 107
Construction Change Directive, Form 109
Request for Information, Form 111
Performance Bond, Form 112
Labor and Material Payment Bond, Form 113
Certificate of Final Acceptance, Form 118
Buy-Safe Montana Form

For most current Montana Prevailing Wage Rates applicable to this project download from this site: http://erd.dli.mt.gov/labor-standards/state-prevailing-wage-rates

2. Viewing of Contract Documents
   2.1. The Contract Documents may be viewed at the following locations:

Builders Exchange of Billings
2050 Broadwater STE A
Billings MT 59102
406/652-1311
bbx@billingsplanroom.com

Bozeman Builders Exchange
1105 Reeves RD W STE 800
Bozeman MT 59718
406/586-7653
exchange@bozemanplanroom.com

Butte Builders Exchange
4801 Hope Road
Butte MT 59701
406/782-5433
butteplans@gmail.com

NW MT - Flathead Builders Exchange
2303 Hwy 2 E
Kalispell, MT 59901
406/755-5888
planex@kalcopy.com

Great Falls Builders Exchange
202 2ND Avenue S
Great Falls MT 59401
406/453-2513
gfbe@greatfallsplans.com

Helena Plans Exchange
1530 Cedar Street Suite C
Helena MT 59601
406/457-2679
helenaplanex@helenacopycenter.com

Missoula Plans Exchange
201 N Russell ST
Missoula MT 59801
406/549-5002
mpe@vemcoinc.com

3. Borrowing of Documents: Up to two hard copy sets may be obtained for General Contractors. Additionally, Contract Documents will be available electronically. If shipping of hard copies is required, it will be at the contractor's expense.

   3.1. Contract Documents may be obtained at the office of:
   MONTANA STATE UNIVERSITY
   UNIVERSITY FACILITIES MANAGEMENT
   PLEW BUILDING 1st FLOOR
   516 W. GRANT ST.
   BOZEMAN, MONTANA 59717-2760
   406/994-5413

   3.2. All borrowed Contract Documents shall be returned to University Facilities Management within ten (10) calendar days after the bid opening for the deposit refund (if deposit was required). However, if the Contract Documents are not in a condition where they can be reused by the

Owner to construct the project, the Owner may at its sole discretion may retain the deposit or levy costs to contractor in order to reproduce a replacement set.

4. Visits to Site

4.1. Prospective bidders are requested to contact the following for inspection of the site:

Donny Beebe, Project Manager
Montana State University
University Facilities Management
516 W. Grant ST., PO Box 172760
Bozeman, Montana 59717-2760
Ph: 406/994-4547; Fax: 406/994-5665

4.2. Failure to visit site will not relieve the Contractor of the conditions of the contract.

5. Requests for Substitution

5.1 Any requests for product substitutions must be submitted on the "Substitution Request" Form 099, to the Architect/Engineer at least ten (10) days prior to the date of the bid opening for consideration by the Architect/Engineer. Any request for substitution made after this time restriction, including those made after award during project construction may be rejected without consideration by either the Architect/Engineer or the Owner.

6. Bids/Proposals

6.1. The bidder shall submit his bid on the Bid Proposal Form furnished with the Contract Documents.

6.2. DO NOT send the Contract Documents with the Proposal. The Contract Documents shall be returned as noted in Article 3.2 of the Instructions to Bidders.

6.3. If the project is funded by any portion of federal funds, the following may apply: on Federally-funded projects, a "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion" form must be submitted with the bid proposal. If the debarment form is not included within the Construction Documents, federal funds (if included) do not require the form or are not included in the project and the debarment form is not required.

6.4. Proposals shall be in a sealed envelope and addressed to:
STATE OF MONTANA, MONTANA STATE UNIVERSITY
UNIVERSITY FACILITIES MANAGEMENT
PLEW BUILDING 1ST FLOOR
516 W. GRANT ST.
PO BOX 172760, BOZEMAN, MONTANA 59717-2760

6.5. The envelope shall state that it contains a "BID PROPOSAL" and indicate the following information:

Name of Project:	**Molecular Bioscience Renovations & Maintenance**
Location:	**Montana State University Bozeman Campus**
MSU PPA Project Number:	**22-0045**
Name of Bidder:	_____
Acknowledge Addendum Number:	__, __, __, __

6.6. It is the bidder's responsibility to deliver or ensure delivery of the bid proposal to Montana State University, University Facilities Management. Proposals received after the scheduled closing time for bids by either the bidder, a delivery service (e.g. Federal Express, U.S. Postal Service, United Parcel Service, etc.), or the state's own mail delivery system, will be rejected. Proposals entitled for consideration must be time-stamped in the Owner's office prior to the closing time for receipt of bids. The official time clock for receipt of bids and fax modifications is the Owner's time and date stamp clock located in the reception area of the Owner's office. No other clocks, calendars or timepieces are recognized. All bidders are responsible to ensure all bids and fax modifications are received in the Owner's office prior to the scheduled closing time.

6.7. If requested on the Bid Proposal, any person making a bid to perform the Work shall, as a requirement of a responsible bid, set forth the name of each subcontractor specified in the "List of Subcontractors" which is part of the bid proposal. The bidder shall list only one subcontractor for each such portion or work listed. The bidder whose bid is accepted shall not:

6.7.1. Substitute any other subcontractor in place of the subcontractor listed in the original bid, except by specific consent of the Owner. The Owner, at its sole discretion, may grant substitution with consent of the originally listed subcontractor, or in consideration of other factor(s) involved if deemed relevant to the successful performance of the Contract.

6.7.2. Permit any such subcontract to be voluntarily assigned, transferred or allow it to be performed by any party other than the subcontractor listed in the original bid without the consent of the Owner.

6.8. Bid Proposals entitled to consideration shall be made in accordance with the following instructions:

6.8.1. Made upon form provided;
6.8.2. All blank spaces properly filled;
6.8.3. All numbers stated in both writing and in figures;
6.8.4. Shall contain no additions, conditional or alternate bids, erasures or other irregularities;
6.8.5. Shall acknowledge receipt of all addenda issued.

6.9. Bid Proposals entitled to consideration shall be signed by the proper representative of the firm submitting the proposal as follows:

6.9.1. The principal of a single owner firm;
6.9.2. A principal of a partnership firm;
6.9.3. An officer of an incorporated firm, or an agent whose signature is accompanied by a certified copy of the resolution of the Board of Directors authorizing that agent to sign; or,
6.9.4. Other persons signing for a single-owner firm or a partnership shall attach a power-of-attorney evidencing his authority to sign for that firm.

6.10. Unit Prices: When a Bid Proposal Form contains unit prices, any errors discovered in the extension of those unit prices will be corrected by the Owner using the unit price figures. The adjusted extended amount will then be used to determine the correct total bid. Only after the amounts have been checked and adjusted, if necessary, will the valid low bid be determined.

6.11. Estimated Quantities: All estimated quantities stipulated in the Bid Proposal and other Contract Documents are approximate and are to be used only as a basis for estimating the probable cost of the work and for the purpose of comparing proposals submitted for the work. It is understood and agreed that the actual amounts of work done, and materials furnished under unit price items may vary from such estimated quantities. The actual quantities will depend on the conditions encountered at the time the work is performed.

6.12. Any bidder may modify his bid by fax communication only.

6.12.1 It is the bidder’s responsibility to ensure that the entire modification is received at the bid opening location prior to the scheduled closing time for receipt of bids. The modification shall not reveal the bid price but shall only provide the ADDITION or SUBTRACTION from the original proposal.

6.12.2 The Owner is not responsible for the performance of the facsimile/printer machine, maintaining adequate paper levels, toner levels, the telephone connection, quality of the facsimile, or any other factors affecting receipt of the fax. Unreadable or difficult-to-read facsimiles may be rejected at the sole discretion of the Owner.

6.12.3 Changes in the listed subcontractors, if any, shall also be provided.

6.12.4 Bid modifications must be verified by hard copy provided to the Owner within two (2) business days after the bid opening.

6.12.5 Bid modifications shall be directed to fax phone (406) 994-5665.

6.12.6 All facsimiles shall be date and time stamped on the same time-stamp clock in the Owner’s office that is used for receipt of bids in order to be considered valid. The Owner may also use the date and time on the automatically-generated email notification of

facsimile receipt as generated by the State's system. Any date and time indicated at the top of the facsimile on either the bidder's or the Owner's facsimile/printer machine will not be used in determining time of arrival of the modification.

6.13. The Owner reserves the sole right to reject any or all bids and to waive any irregularities or informalities. The Owner also reserves the sole right to determine what constitutes irregularities or informalities and/or what is material and/or immaterial to the bids received.

7. Bid Security

7.1. IF THE PROJECT COST IS LESS THAN $25,000, AT ITS SOLE DISCRETION THE STATE OF MONTANA MAY OR MAY NOT REQUIRE BID SECURITY (18-2-302 MCA).

7.2. Proposals over $150,000 shall be accompanied by a bid security in the amount of 10% of the bid price, as evidence of good faith (18-2-302 MCA).

7.3. Bid security shall be in the form of lawful moneys of the United States, cashier's check, certified check, bank money order or bank draft, bid bond or bonds payable to the State of Montana (18-2-302 MCA).

7.4. If the bidder, to whom a contract is awarded, fails to enter into and execute the proposed contract within fifteen (15) calendar days of award, the bidder shall forfeit the bid security (18-1-204 MCA).

7.5. The bid security of unsuccessful bidders will be returned when the contract has been awarded to the successful bidder or when all bids have been rejected (18-1-205 MCA).

7.6. Execution of and entering into a contract includes providing all necessary insurance certificates, bonds, signed contract and current copy of the construction contractor registration certificate.

7.7. **NOTE: PER STATE POLICY, IF CASH, CHECK, MONEY ORDER, OR BANK DRAFT ARE PROVIDED AS BID SECURITY, IT WILL BE DEPOSITED IN THE TREASURY. UNSUCCESSFUL BIDDERS WILL HAVE THEIR SECURITY RETURNED UPON CONTRACT AWARD. THE SUCCESSFUL BIDDER'S SECURITY MAY BE RETURNED UPON THE SIGNATURE BY BOTH CONTRACTOR AND OWNER ON THE CONTRACT FOR CONSTRUCTION.**

8. Withdrawal of Bids

8.1. Any bidder may withdraw his bid proposal at any time prior to the scheduled closing time for the receipt of bids.

8.2. Once the closing time for the receipt of bids is reached, a bid may not be withdrawn for a period of thirty (30) calendar days.

9. Interpretation of Contract Documents

9.1. Bidders shall promptly notify the Architect/Engineer of any ambiguity, inconsistency, or error which they may discover upon examination of the Contract Documents or of the site and local conditions.

9.2. Bidders requiring clarification or interpretation of the Contract Documents shall request, in writing, clarification from the Architect/Engineer at least ten (10) calendar days prior to the date set for receipt of bids.

9.3. Any interpretations, corrections, or change in the Contract Documents prior to the bid opening will be made by written addendum issued by the Architect/Engineer. The Architect/Engineer will endeavor to notify all plan holders of any addenda issued but it shall be the responsibility of the individual bidders to insure they have received all addenda prior to the submission of their bid.

9.4. All written addenda issued by the Architect/Engineer will become part of the Contract Documents and all bidders shall be bound by such addenda whether or not received and/or acknowledged by the bidder. No oral or telephone modifications of the Contract Documents will be considered or allowed.

10. Award of Bids

10.1. All bids received by the stated hour will be opened and publicly read aloud.

10.2. The Owner reserves the right to reject any and all bids and to waive any informality or irregularity in any bid received. Owner reserves the right to determine what constitutes material and/or immaterial informalities and/or irregularities.

10.3. The low bid shall be determined on the basis of the lowest Base Bid or the lowest combination of Base Bid and Alternate Bids, accepted in consecutive order.

10.4. The Owner shall award such contract to the lowest responsible bidder (18-1-102 MCA).

10.4.1. The Owner may make such investigations as it deems necessary to determine whether or not any or all bidders are responsible.
10.4.2. The term “responsible” does not refer to pecuniary ability only, nor the ability to tender sufficient performance and payment bonds.
10.4.3. The term “responsible” includes, but is not limited to:
10.4.3.1. Having adequate financial resources to perform the contract or the ability to obtain them;
10.4.3.2. Being able to comply with the required delivery, duration, and performance schedule;
10.4.3.3. Having a satisfactory record of integrity and business ethics;
10.4.3.4. Having the necessary organization, experience, accounting, and operational controls;
10.4.3.5. Having the necessary production, construction, technical equipment, and facilities; and,
10.4.3.6. Having the technical skill, ability, capacity, integrity, performance, experience, lack of claims and disputes, lack of actions on bonds, lack of mediations, arbitrations and/or lawsuits related to construction work or performance, and such like.
10.4.4. Bidders shall furnish to the Owner all information and data for this purpose as the Owner may request.
10.4.5. The Owner reserves the right to reject any bid if the investigation or evidence of any Bidder fails to satisfy the Owner that such Bidder is properly and adequately qualified to suitably perform and satisfactorily execute the obligations of the Contract and Work defined in the Contract Documents.

10.5. The Owner shall award such contract to the lowest responsible bidder without regard to residency except on a reciprocal basis: a resident bidder will be allowed a preference on a contract against the bid of any non-resident bidder from any state or country that enforces a preference for resident bidders. The preference given to resident bidders of the State of Montana must be equal to the preference given in the other state or country (18-1-102, MCA). This does not apply when prohibited by Federal requirements.

10.6. The State of Montana may negotiate deductive changes, not to exceed 15% of the total cost of the project, with the lowest responsible bidder when the lowest responsible bids causes the project cost to exceed the appropriation; or with the lowest responsible bidders if multiple contracts will be awarded on the projects when the total of the lowest responsible bids causes the project cost to exceed the appropriation. A bidder is not required to negotiate his bid but is required to honor his bid for the time specified in the bidding documents. The Owner may terminate negotiations at any time (18-2-105(7) MCA).

11. Contract

11.1. The sample Standard Form of Contract between Contractor and Owner, as issued by the Owner, will be used as the contracting instrument and is bound within the Contract Documents.

11.2. The form shall be signed by a proper representative of the bidder as defined above in these instructions.

11.3. The contractor shall also complete and return a federal form W-9 with the Contract.

12. Performance, Labor and Material Payment Security

    12.1. IF THE PROJECT COST IS LESS THAN $150,000, AT ITS SOLE DISCRETION THE STATE OF MONTANA MAY OR MAY NOT REQUIRE A PERFORMANCE OR LABOR AND MATERIAL PAYMENT SECURITY (18-2-201 MCA). (**MSU REQUIRES BONDS ON ALL PROJECTS ABOVE $150,000.)**

    12.2. THE CONTRACTOR SHALL PROVIDE BOTH SECURITIES FOR THIS PROJECT AS SPECIFIED BELOW, UNLESS SPECIFICALLY DIRECTED THAT THIS REQUIREMENT HAS BEEN WAIVED ELSEWHERE IN THESE DOCUMENTS.

    12.3. The Owner shall require the successful bidder to furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201, MCA).

    12.4. The Owner shall require the successful bidder to furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201 MCA).

    12.5. The bonds shall be executed on forms furnished by the Owner. No other forms will be acceptable.

    12.6. The bonds shall be signed in compliance with State statutes (33-17-111 MCA).

    12.7. Bonds shall be secured from a State licensed bonding company.

    12.8. Power of Attorney

        12.8.1. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney;
        12.8.2. One original copy shall be furnished with each set of bonds.
        12.8.3. Others furnished with a set of bonds may be copies of that original.

13. Notice To Proceed

    13.1. The successful bidder who is awarded the contract for construction will **NOT** be issued a Notice to Proceed document for this project. The contract for construction shall include the dates for project commencement and completion and shall serve as a Notice to Proceed for the outlined work.

14. Laws and Regulations

    14.1. The bidders' attention is directed to the fact that all applicable federal and state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over the project shall apply to the contract throughout and will be deemed to be included in this contract as if bound herein in full.

15. Payments

    15.1. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.

16. Buy Safe Montana Provisions

    16.1. The successful bidder who is awarded the contract for construction shall provide their incident rate, experience modification ratio (EMR) and loss ratio via the Buy-Safe Montana form with the Award documents.

17. Time of Completion

17.1. Bidder agrees to commence work immediately upon receipt of the Standard Form of Contract Between Owner and Contractor for Construction upon the specified date of commencement, and to substantially complete the project by **April 3, 2028**.

17.2. If liquidated damages are assessed for exceeding the completion date, they shall accrue at the rate of **50,000/100 ($500.00) DOLLARS** per calendar day. Liquidated damages charges will be deducted from the amount due the Contractor.

~END OF INSTRUCTIONS~

MONTANA STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT
Sixth Avenue and Grant Street • PO Box 172760 • Bozeman, Montana 59717-2760
Phone: (406) 994-5413 • Fax: (406) 994-5665

BID PROPOSAL

Molecular Bioscience Building Renovations and Maintenance
PPA No. 22-0045

TO:
State of Montana, Montana State University
University Facilities Management
Attn: Contract Administrator
Plew Building, 516 W. Grant St.
PO Box 172760
Bozeman, Montana 59717-2760

Prospective Bidders:

The undersigned, having familiarized themselves with the Contract Documents, site, location, and conditions of the Work as prepared by **BECHTLE ARCHITECTS, 4515 VALLEY COMMONS DRIVE, #201, BOZEMAN, MT 59718, (406) 585-4161,** by submission of this Bid Proposal, hereby agrees to provide all materials, systems, equipment and labor necessary to complete the Work for the total sum as follows:

BASE BID:

_____ and _____ /100 DOLLARS
(ALPHA notation)

$_____
(NUMERIC notation)

LIST OF SUBCONTRACTORS

This section must be completed to meet the requirements of a responsive bid (The Owner still retains the right to determine whether or not this requirement is an irregularity or informality in the bids submitted). If work will be performed by the General Contractor, enter the name of the General Contractor. Should Alternates be included in the bid proposal, and the listed subcontractors change based upon the pricing of the alternates, the General Contractor shall provide a listing or notation of the change in subcontractors for each alternate for each description of the work.

DESCRIPTION OF WORK	SUBCONTRACTOR
[i.e. Mechanical insert here]	_____
[i.e. Electrical insert here]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____
[Description of Work]	_____

This bidder acknowledges receipt of the following addenda:

ADDENDUM No.: _____ Dated: _____
ADDENDUM No.: _____ Dated: _____
ADDENDUM No.: _____ Dated: _____

By signing below, the bidder agrees to all terms specified and AGREES TO fulfill the requirements of the CONTRACT in strict accordance with the bidding documents.

Company Name: _____

Business Address: _____

_____

_____

Construction Contractor Registration No.: _____

Phone No.: _____

Fax No.: _____

Email: _____

Date: _____

Bid Proposals entitled to consideration shall be signed by the proper representative of the firm submitting the proposal as follows (Initial which requirement you meet):

☐ The principal of a single owner firm;

☐ A principal of a partnership firm;

☐ An officer of an incorporated firm, or an agent whose signature is accompanied by a certified copy of the resolution of the Board of Directors authorizing that agent to sign; or (attach a copy of the resolution),

☐ Other persons signing for a single-owner firm or a partnership shall attach a power-of-attorney evidencing his authority to sign for that firm.

Signature: _____

Print Name: _____

Title: _____

Contract documents should be sent to the firm representative with information as follows:

Signature: _____

Print Name: _____

Email: _____

MONTANA
STATE UNIVERSITY

FACILITIES SERVICES
Sixth Avenue and Grant Street • PO Box 172760 • Bozeman, Montana 59717-2760
Phone: (406) 994-5413 • Fax: (406) 994-5665

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

(Form Revision Date: January 2026)

ARTICLE 1 – GENERAL PROVISIONS

1.1. BASIC DEFINITIONS

1.1.1. CONTRACT DOCUMENTS. The Contract Documents consist of the Contract between Owner and Contractor (hereinafter the "Contract"), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Contract and Modifications issued after execution of the Contract. A Modification is: (1) a written amendment to the Contract signed by both parties; (2) a Change Order; (3) a Construction Change Directive; or, (4) a written order for a minor change in the Work issued by the Architect/Engineer. The Contract Documents shall include the bidding documents and any alterations made thereto by addenda. In the event of a conflict, discrepancy, contradiction, or inconsistency within the Contract Documents and for the resolution of same, the following order of hierarchy and control shall apply and prevail:

1) Contract; 2) Addenda; 3) Supplementary General Conditions; 4) General Conditions; 5) Specifications; 6) Drawings; 7) Instructions to Bidders; 8) Invitation To Bid; 9) Sample Forms.

1.1.1.1. If a conflict, discrepancy, contradiction, or inconsistency occurs within or between the Specifications and the Drawings, resolution shall be controlled by the following:

1.1.1.1.1. As between figures, dimensions, or numbers given on drawings and any scaled measurements, the figures, dimensions, or numbers shall govern;
1.1.1.1.2. As between large scale drawings and small scale drawings, the larger scale drawings shall govern;
1.1.1.1.3. As between the technical specifications and drawings; the technical specifications shall govern.
1.1.1.1.4. Shop Drawings and Submittals: Shop drawings and other submittals from the Contractor, subcontractors, or suppliers do not constitute a part of the Contract Documents.

1.1.1.2. The Contractor acknowledges, understands and agrees that the Contract Documents cannot be changed except as provided herein by the terms of the Contract. No act(s), action(s), omission(s), or course of dealing(s) by the Owner or Architect/Engineer with the Contractor shall alter the requirements of the Contract Documents and that alteration can be accomplished only through a written Modification process defined herein.

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

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

1.1.4. THE CONTRACT. The entire Contract for Construction is formed by the Contract Documents. The Contract represents the entire, complete, and integrated agreement between the Owner and Contract

hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between: (1) the Architect/Engineer and Contractor; (2) the Owner and any Subcontractor, Sub-subcontractor, or Supplier; (3) the Owner and Architect/Engineer; or, (4) between any persons or entities other than the Owner and Contractor. However, the Architect/Engineer shall at all times be permitted and entitled to performance and enforcement of its obligations under the Contract intended to facilitate performance of the Architect/Engineer's duties.

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

1.1.6. THE PROJECT. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.

1.1.7. TIME. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day of a duration or time period shall be determined as the day following the current day of any event or notice starting a specified duration. All durations in the Contract Documents are calendar days unless specifically stated otherwise.

1.2. CORRELATION, INTER-RELATIONSHIP, AND INTENT OF THE CONTRACT DOCUMENTS

1.2.1. The intent of the Contract Documents is to include all items and all effort necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and inter-related, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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

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

1.3. CAPITALIZATION

1.3.1. Terms capitalized in these General Conditions include those which are: (1) specifically defined; and, (2) the titles of numbered articles and identified references to Paragraphs, Subparagraphs and Clauses in the document.

1.4. INTERPRETATION

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

1.5. EXECUTION OF THE CONTRACT AND CONTRACT DOCUMENTS

1.5.1. The Contract shall be signed by the Owner and Contractor. Execution of the Contract by the Contractor constitutes the complete and irrevocable binding of the Contractor and his Surety to the Owner for complete performance of the Work and fulfillment of all obligations. By execution of the Contract, the Contractor acknowledges that it has reviewed and familiarized itself with all aspects of the Contract Documents and agrees to be bound by the terms and conditions contained therein.

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

1.5.3. The Contractor acknowledges that it has taken all reasonable actions necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to: (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, gas, electric power, phone service, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation, topography, and conditions of the ground; and, (5) the character of equipment and facilities needed for performance of the Work. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory geotechnical work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the action described and acknowledged in this paragraph will not relieve the Contractor from responsibility for properly ascertaining and estimating the difficulty and cost of successfully performing the Work or for proceeding to successfully perform the Work without additional expense to the Owner.

1.5.4. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Owner, nor does the Owner assume responsibility for any understanding reached or representation made by any of its officers, agents, or employees concerning conditions which can affect the Work unless that understanding or representation is expressly stated in the Contract Documents.

1.5.4.1. Performance of any portion of the Work beyond that required for complying with the specifications and all other requirements of the Contract, shall be deemed to be for the convenience of the Contractor and shall be at the Contractor's sole expense.

1.5.4.2. There shall be no increase in the contract price or time allowed for performance which is for the convenience of the Contractor.

1.6. OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER INSTRUMENTS OF SERVICE

1.6.1. The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect/Engineer and the Architect/Engineer's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect/Engineer or the Architect/Engineer's consultants. Unless otherwise indicated, the Architect/Engineer and the Architect/Engineer's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights except as defined in the Owner’s Contract with the Architect/Engineer. All copies of Instruments of Service, except the Contractor's record set, shall be returned or suitably accounted for to the Architect/Engineer upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect/Engineer, and the Architect/Engineer's consultants. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect/Engineer's or Architect/Engineer's consultants' copyrights or other reserved rights.

1.6.2. Owner's Disclaimer of Warranty: The Owner has requested the Architect/Engineer prepare the Contract Documents for the Project which are adequate for bidding and constructing the Project. However, the Owner makes no representation, guarantee, or warranty of any nature whatsoever to the Contractor concerning such documents. The Contractor hereby acknowledges and represents that it has not, does not, and will not rely upon any such representation, guarantee, or warranty concerning the Contract Documents as no such representation, guarantee, or warranty have been or are hereby made.

ARTICLE 2 – THE OWNER

2.1. THE STATE OF MONTANA

2.1.1. The Owner is the State of Montana and is the sole entity to be identified as Owner in the Contract and as referred to throughout the Contract Documents as if singular in number.

2.1.2. Except as otherwise provided in Subparagraph 4.2.1, the Architect/Engineer does not have authority to bind the Owner. The observations and participations of the Owner or its authorized representative do not alleviate any responsibility on the part of the Contractor. The Owner reserves the right to observe the work and make comment. Any action or lack of action by the Owner shall not be construed as approval of the Contractor's performance.

2.1.3. The Owner reserves the right to require the Contractor, all sub-contractors and material suppliers to provide lien releases at any time. The Owner reserves the right to withhold progress payments until such lien releases are received for all work for which prior progress payments have been made. Upon the Owner's demand for lien releases (either verbally or written), the Contractor, all sub-contractors and material suppliers shall provide such releases with every subsequent application for payment through Final Acceptance of the Project.

2.1.4. Except for permits and fees, including those required under Subparagraph 3.7.1, which are the responsibility of the Contractor under the Contract Documents, the Owner shall secure and pay for initial plan review and building permit, necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

2.1.5. Information or services required of the Owner by the Contract Documents shall be furnished by the Owner with reasonable promptness. Any other information or services relevant to the Contractor's performance of the Work under the Owner's control shall be furnished by the Owner after receipt from the Contractor of a written request for such information or services.

2.1.6. Unless otherwise provided in the Contract Documents, the Contractor will be furnished electronic copies of Drawings and Specifications as are reasonably necessary for execution of the Work.

2.2. OWNER'S RIGHT TO STOP WORK

2.2.1. If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Paragraph 12.2 or persistently fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated. However, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 6.1.3. The issuance of a stop work order by the Owner shall not give rise to a claim by the Contractor or any subcontractor for additional cost, time, or other adjustment.

2.3. OWNER'S RIGHT TO CARRY OUT THE WORK

2.3.1. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a three-day period. If the Contractor within such three-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be

issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and increased costs, and compensation for the Architect/Engineer's additional services made necessary by such default, neglect, or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

2.4. OWNER'S RIGHT TO PERSONNEL

2.4.1. The Owner reserves the right to have the Contractor and/or subcontractors remove person(s) and/or personnel from any and all work on the project with cause but without cost to the Owner. Such requests from the Owner may be made verbally or in writing and may be done directly with the Contractor or indirectly through the Architect/Engineer. Cause may be, but not limited to, any of the following: incompetence, poor workmanship, poor scheduling abilities, poor coordination, disruption to the facility or others, poor management, causes delay or delays, disruption of the Project, will not strictly adhere to facility procedures and Project requirements either knowingly or unknowingly, insubordination, drug/alcohol use, possession of contraband, belligerent acts or actions, etc. The Contractor shall provide replacement person(s) and/or personnel acceptable to the Owner at no cost to the Owner.

2.4.2. Any issue or circumstance relating to or resulting out of this clause shall not be construed or interpreted to be interference with or impacting upon the Contractor's responsibilities and liabilities under the Contract Documents.

2.4.3. Person(s) and/or personnel who do not perform in accordance with the Contract Documents, shall be deemed to have provided the Owner with cause to have such persons removed from any and all involvement in the Work.

2.4.4. The Contractor agrees to indemnify and hold harmless the Owner from any and all causes of action, demands, claims, damages, awards, attorneys' fees, and other costs brought against the Owner and/or Architect/Engineer by any and all person(s) or personnel as a result of actions under this clause.

ARTICLE 3 – THE CONTRACTOR

3.1. GENERAL

3.1.1. The Contractor is the person or entity identified as such in the Contract and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative.

3.1.2. Construction Contractor Registration: The Contractor is required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. A bidder must demonstrate that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work. If the prevailing bidder cannot or does not register in time for the Owner to execute the Contract within fifteen (15) days of the date on the notice of award, the Owner may award, at its sole discretion, to the next lowest responsible bidder who meets this requirement. The Owner will not execute a contract for construction to a Contractor who is not registered per 39-9-401(a) MCA. It is solely the Contractor's responsibility to ensure that all Subcontractors are registered in accordance with Title 39, Chapter 9, MCA.

3.1.3. The Owner's engagement of the Contractor is based upon the Contractor's representations by submission of a bid to the Owner that it:

3.1.3.1. has the requisite skills, judgment, capacity, expertise, and financial ability to perform the Work;

3.1.3.2. is experienced in the type of labor and services the Owner is engaging the Contractor to perform;

3.1.3.3. is authorized, licensed and registered to perform the type of labor and services for which it is being engaged in the State and locality in which the Project is located;

3.1.3.4. is qualified, willing and able to perform the labor and services for the Project in the manner and scope defined in the Contract Documents; and,

3.1.3.5. has the expertise and ability to provide labor and services that will meet the Owner's objectives, intent and requirements, and will comply with the requirements of all governmental, public, and quasi-public authorities and agencies having or asserting jurisdiction over the Project.

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

3.1.5. The Contractor shall provide on minimum of a bi-weekly basis the onsite Superintendent's daily reports/logs

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

3.1.7. Quality Control (i.e. ensuring compliance with the Contract Documents) and Quality Assurance (i.e. confirming compliance with the Contract Documents) are the responsibility of the Contractor. Testing, observations, and/or inspections performed or provided by the Owner are solely for the Owner's own purposes and are for the benefit of the Owner. The Owner is not liable or responsible in any form or fashion to the Contractor regarding quality control or assurance or extent of such assurances. The Contractor shall not, under any circumstances, rely upon the Owner's testing or inspections as a substitute or in lieu of its own Quality Control or Assurance programs.

3.1.8. Buy-Safe Montana Provision: The Owner shall review the Buy-Safe Montana Form provided by the Bidder under Articles 16 of the Instructions to Bidders. To promote a safe work environment, the Owner encourages an incidence rate less than the latest average for non-residential building construction for Montana as established by the federal Bureau of Labor Statistics for the prior year; an experience modification rating (EMR) less than 1.0; and a loss ratio of less than 100%. The Contractor with a greater-than-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100% shall schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before the Owner grants Substantial Completion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit http://erd.dli.mt.gov/safety-health/onsite-consultation.

3.2. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.1. Since the Contract Documents are complementary and inter-related, before starting each portion of the Work, the Contractor shall carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions affecting the Work. These obligations are for the purpose of facilitating construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents. However, any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Architect/Engineer as a request for information in such form as the Architect/Engineer may require.

3.2.2. Any errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect/Engineer, but it is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

3.2.3. If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect/Engineer in response to the Contractor's notices or requests for information pursuant to Subparagraphs 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Subparagraphs 4.3.4 and 4.3.5. If the Contractor fails to perform the obligations of Subparagraphs 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect/Engineer for damages resulting from errors, inconsistencies, or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents

unless the Contractor recognized such error, inconsistency, omission or difference and failed to report it to the Architect/Engineer.

3.2.4. Except as otherwise expressly provided in this Contract, the Contractor assumes all risks, liabilities, costs, and consequences of performing any effort or work in accordance with any written or oral order (including but not limited to direction, instruction, interpretation, or determination) of a person not authorized in writing by the Owner to issue such an order.

3.2.5. By entering into this Contract, the Contractor acknowledges that it has informed itself fully regarding the requirements of the Drawings and Specifications, the General Conditions, the Supplementary General Conditions, all other documents comprising a part of the Contract Documents and all applicable laws, building codes, ordinances and regulations. Contractor hereby expressly acknowledges, guarantees, and warrants to the Owner that:

3.2.5.1. the Contract Documents are sufficient in detail and scope to enable Contractor to construct the finished project;

3.2.5.2. no additional or further work should be required by Owner at the time of Owner's acceptance of the Work; and,

3.2.5.3. when the Contractor's work is finished and the Owner accepts, the Work will be complete and fit for the purpose intended by the Contract Documents. This acknowledgment and guarantee does not imply that the Contractor is assuming responsibilities of the Architect/Engineer.

3.2.6. Sufficiency of Contract Documents: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has received, carefully reviewed, and evaluated all aspects of the Contract Documents and agrees that said Documents are adequate, consistent, coordinated, and sufficient for bidding and constructing the Work requested, intended, conceived, and contemplated therein.

3.2.6.1. The Contractor further acknowledges its continuing duty to review and evaluate the Contract Documents during the performance of its services and shall immediately notify the Architect/Engineer of any problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions it discovers in the Contract Documents and the Work to be constructed; and, any variances it discovers between the Contract Documents and applicable laws, statutes, building codes, rules or regulations.

3.2.6.2. If the Contractor performs any Work which it knows or should have known due to its experience, ability, qualifications, and expertise in the construction industry, that involves problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions in the Contract Documents and the Work to be constructed and, any variances between the Contract Documents and applicable laws, statutes, building codes, rules or regulations, without prior written notification to the Architect/Engineer and without prior authorization to proceed from the Architect/Engineer, the Contractor shall be responsible for and bear the costs and delays (including costs of any delay) of performing such Work and all corrective actions as directed by the Architect/Engineer.

3.2.6.3. Any and all claims resulting from the Contractor’s failure, including those of any subcontractor or supplier, to carefully review, evaluate, and become familiar with all aspects of the Contract Documents shall be deemed void and waived by the Contractor.

3.2.7. Sufficiency of Site Conditions: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has visited, carefully reviewed, evaluated, and become familiar with all aspects of the site and local conditions at which the Project is to be constructed. The Contractor agrees that the Contract Documents are an adequate, consistent, coordinated, and sufficient representation of the site and local conditions for the Work.

3.2.7.1. The Contractor has reviewed and become familiar with all aspects with the Site Survey and Geotechnical Report for the Project and has a full understanding of the information provided therein.

3.2.7.2. If the Work involves modifications, renovations, or remodeling of an existing structure(s) or other man-made feature(s), the Contractor certifies, warrants and guarantees that it has reviewed, evaluated, and become familiar with all available as-built and record drawings, plans and specifications, and has thoroughly inspected and become familiar with the structure(s) or man-made feature(s).

3.2.7.3. Any and all claims resulting from the Contractor's failure, including those of any subcontractor or supplier, to visit, carefully review, evaluate, and become familiar with all aspects of the site, available geotechnical information, and local conditions at which the Project is to be constructed shall be deemed void and waived by the Contractor.

3.3. SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.1. The Contractor shall supervise and direct the Work using the Contractor's best skill and attention recognizing that time and quality are of the essence of the Work. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. It is the responsibility of and incumbent upon the Contractor to ensure, confirm, coordinate, inspect and oversee all Work (which is inclusive of but not limited to all submittals, change orders, schedules, workmanship, and appropriate staffing with enough competent and qualified personnel) so that the Work is not impacted in terms of any delays, costs, damages, or additional time, or effort on the part Architect/Engineer or Owner. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect/Engineer and shall not proceed with that portion of the Work without further written instructions from the Architect/Engineer. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Architect/Engineer or Owner as appropriate shall be solely responsible for any resulting loss or damage. The Contractor will be required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and shall propose any alternative procedure which the Contractor will warrant and guarantee. The Contractor is required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and to propose any alternative procedure which the Contractor will warrant.

3.3.2. The Contractor shall furnish management, supervision, coordination, labor and services that: (1) expeditiously, economically, and properly completes the Work; (2) comply with all requirements of the Contract Documents; and, (3) are performed in a quality workmanlike manner and in accordance with the standards currently practiced by persons and entities performing or providing comparable management, supervision, labor and services on projects of similar size, complexity, cost, and nature to this Project. However, the standards currently practiced within the construction industry shall not relieve the Contractor of the responsibility to perform the Work to the level of quality, detail, and excellence defined and intended by the Contract Documents as interpreted by the Architect/Engineer.

3.3.3. All services and labor rendered by the Contractor, including any subcontractors or suppliers, shall be performed under the immediate supervision at the site of persons possessing expertise and the requisite knowledge in the discipline or trade of service being rendered. The Contractor shall maintain such supervision and personnel at all times that the Contractor's personnel, subcontractors, and/or suppliers are at the site. The Contractor shall never be absent from the site during performance of any portion of the Work by any entity under the supervision and direction of the Contractor. Full time attendance by the Contractor from the date of project commencement through Final Acceptance is an explicit requirement of this Contract.

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

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

3.4. LABOR, WAGES, AND MATERIALS

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

3.4.2. The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order. This opportunity to request substitutions does not negate or waive any requirement for the Contractor to follow a pre-bidding “prior approval” requirement nor obligate the Owner to approve any substitution request.

3.4.3. The Contractor shall enforce strict discipline, appropriate behavior, and good order among the Contractor's employees, subcontractors at every tier and level, and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.4.4. Prevailing Wages and Montana Residents.

3.4.4.1. The Contractor and all subcontractors at any level or tier of the Work shall give preference to the employment of bona fide Montana residents in the performance of the Work and shall pay the standard prevailing rate of wages, including fringe benefits for health and welfare and pension contributions and travel allowance provisions in effect and applicable to the county or locality in which the work is being performed. (18-2-403, MCA)

3.4.4.2. At least 50% of the workers, as defined by the Department of Labor & Industry (DOLI), must be bona fide Montana residents. (18-2-401, 18-2-402, MCA)

3.4.4.3. Indian Employment Preference within the Boundaries of an Indian Reservation. All contractors that are awarded a state agency construction contract within the exterior boundaries of an Indian Reservation shall extend a hiring preference to qualified Indians as provided herein:

3.4.4.3.1. “State agency” means a department, office, board, bureau, commission, agency, or other instrumentality of the executive or judicial branches of the government of this State. “Indian” means a person who is enrolled or who is a lineal descendent of a person enrolled in an enrollment listing of the Bureau of Indian Affairs or in the enrollment listing of a recognized Indian tribe domiciled in the United States.

3.4.4.3.2. Qualified Indians – Employment Criteria: An Indian shall be qualified for employment in a permanent, temporary, or seasonal position if he or she has substantially equal qualifications for any position and resides on the reservation where the construction contract is to be performed.

3.4.4.3.3. Non-Applicability: The Indian Employment Preference Policy does not apply to a project partially funded with federal-aid money from the United States Department of Transportation or when residency preference laws are specifically prohibited by federal law. It does not apply to independent contractors and their employees, student interns, elected officials, or appointed positions.

3.4.4.4. The Commissioner of The Montana Department of Labor and Industry (DOLI) has established the standard prevailing rate of wages in accordance with 18-2-401 and 18-2-402, MCA. A copy of the Rates entitled "State of Montana, Prevailing Wage Rates" are bound herein. The Commissioner of the Montana DOLI has established the resident requirements in accordance

with 18-2-409, MCA. The Contractor and all subcontractors at any level or tier of the Work shall direct any and all questions concerning prevailing wage and Montana resident issues for all aspects of the Work to DOLI.

3.4.4.5. The Contractor and all subcontractors at any tier or level of the Work, and as determined by the Montana DOLI, shall classify all workers in the project in accordance with the State of Montana, Prevailing Wage Rates. In the event the Contractor is unable to classify a worker in accordance with these rates he shall contact DOLI for a determination of the classification and the prevailing wage rate to be paid.

3.4.4.6. The Contractor and all subcontractors at any tier or level of the Work shall be responsible for obtaining wage rates for all workers prior to their performing any work on the project. The Contractor is required to pay and insure that its subcontractors at any tier or level and others also pay the prevailing wage determined by the DOLI, insofar as required by Title 18 of the MCA and the pertinent rules and standards of DOLI.

3.4.4.7. It is not the responsibility of the Owner to determine who classifies as a subcontractor, sub-subcontractor, material man, supplier, or any other person involved in any aspect of the Work at any tier or level. All such determinations shall be the sole responsibility of the Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project at any tier or level. The Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project shall indemnify and hold harmless the Owner from all claims, attorneys' fees, damages and/or awards involving prevailing wage or Montana resident issues. Any changes to wages or penalties for failure to pay the correct wages will be the sole responsibility of the Contractor and/or his subcontractors and no further charges or claims shall be made to the Owner. If the parties mutually agree or an arbitrator or court determines that any change in wages is due and any part is attributable to the Owner, the Owner's sole liability shall be for the amount of wages ordered only and not for other expenses, charges, penalties, overhead, profit or other mark-ups.

3.4.4.8. In accordance with 18-2-422(1) MCA, each job classification's standard prevailing wage rate, including fringe benefits, that the contractors and employers shall pay during construction of the project is included herein by both reference to DOLI's "Building" or 'Heavy/Highway" schedules and as part of these Contract Documents.

3.4.4.9. The Contractor and every employer, including all subcontractors at any tier or level, is required by 18-2-422(2) MCA to maintain payroll records in a manner readily capable of being certified for submission under 18-2-423 MCA, for a period of not less than 3 years after the contractor's, subcontractor's, or employer's completion of work on the project or the Final Acceptance by the Owner, whichever is later.

3.4.4.10. Each contractor is required by 18-2-422(3) MCA to post in a visible and accessible location a statement of all wages and fringe benefits in compliance with 18-2-423.

3.4.4.11. The contractor and all subcontractors are required by MCA 18-2-417 to make wage rate adjustments for projects with a construction duration exceeding 30 months.

3.5. **WARRANTY AND GUARANTEE**

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

3.5.2. The Contractor shall and does hereby warrant and guarantee all work, workmanship, and materials for the full warranty period as specified in the Contract Documents. The warranty period shall be defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project by the Owner. The date of Final Acceptance shall be the date of the Architect/Engineer's signature on the final request for payment unless otherwise agreed upon in writing for the entire project or any portion thereof, by the Owner, Architect/Engineer and Contractor.

3.5.3. In addition to the one (1) calendar year warranty and guarantee specified in this herein above, the Contractor warrants and guarantees all materials and workmanship for the roofing system for a period of two (2) calendar years from the date of Final Acceptance. This warranty shall cover all labor and materials for roof and roofing finish systems (e.g. flashing, terminations, parapet caps, etc.) repairs from moisture penetration and/or defects in workmanship.

3.5.4. Manufacturer and product warranties and guarantees, as provided by the manufacturer or as specified in the Contract Documents, are in addition to the Contractor's warranty.

3.6. TAXES

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

3.6.2. In compliance with 15-50-206 MCA, the Contractor will have 1% of his **gross** receipts withheld by the Owner from all payments due and sent to the Montana Department of Revenue. Each subcontractor who performs work greater than $80,000 shall have 1% of its gross receipts withheld by the Contractor and sent to the Montana Department of Revenue. The Contractor shall notify the Department of Revenue on the Department's prescribed form.

3.7. PERMITS, FEES, AND NOTICES

3.7.1. Unless otherwise provided in the Contract Documents, the Owner shall pay for plan review and building permit fees, and the Contractor shall secure and pay for other permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work which are customarily secured after execution of the Contract, including but not limited to, the building permit fee, electrical, plumbing, sewer connection fee and mechanical permit fee, and any required impact fees and which are legally required when bids are received or negotiations concluded.

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

3.7.3. If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations, and does so without providing notice to the Architect/Engineer and Owner, the Contractor shall assume responsibility for such Work and shall bear the costs attributable to correction. The Contractor shall be solely responsible to ensure that all work it performs is in full compliance with all prevailing and applicable codes and regulations.

3.7.4. Incident Reporting: The Contractor shall immediately notify the Owner and Architect/Engineer, both orally and in writing, of the nature and details of all incidents which may adversely affect the quality or progress of the Work, including, but not limited to, union disputes, accidents, delays, damages to Work, and other significant occurrences. Such notices are in addition to any other notices required regarding claims.

3.8. ALLOWANCES

3.8.1. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.

3.8.2. Unless otherwise provided in the Contract Documents:

3.8.2.1. allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

3.8.2.2. Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included by the Contractor in the Contract Sum but not in the allowances;

3.8.2.3. whenever costs are more than or less than stated allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect: (1) the difference between actual costs and the allowances under Clause 3.8.2.1; and, (2) changes in Contractor's costs under Clause 3.8.2.2.

3.8.3. Materials and equipment under an allowance shall be selected by the Owner.

3.9. CONTRACTOR'S PERSONNEL

3.9.1. The Contractor shall employ competent personnel, supervisors, project managers, project engineers, project superintendent, and all others who shall be assigned to the Work throughout its duration. Contractor's personnel extend to those employed by the Contractor whether at the site or not. The Owner shall have right to review and approve or reject all replacement of Contractor's personnel. All personnel assigned by the Contractor to the Work shall possess the requisite experience, skills, abilities, knowledge, and integrity to perform the Work.

3.9.2. The superintendent and others as assigned shall be in attendance at the Project site during the performance of any and all Work. The superintendent shall represent the Contractor. All communications given to the Contractor's personnel such as the project manager or the superintendent, whether verbal, electronic or written, shall be as binding as if given to the Contractor.

3.9.3. It is the Contractor's responsibility to appropriately staff, manage, supervise and direct the Work which is inclusive of the performance, acts, and actions of his personnel and subcontractors. As such, the Contractor further agrees to indemnify and hold harmless the Owner and the Architect/Engineer, and to protect and defend both from and against all claims, attorneys' fees, demands, causes of action of any kind or character, including the cost of defense thereof, arising in favor of or against the Owner, Architect/Engineer, Contractor, their agents, employees, or any third parties on account of the performance, behavior, acts or actions of the Contractor's personnel or subcontractors.

3.9.4. Prior to the commencement of any work, the Contractor shall prepare and submit a personnel listing and organizational chart in a format acceptable to the Owner which lists by name, phone number (including cell phone), job category, and responsibility the Contractor's key/primary personnel who will work on the Project. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference.

3.9.5. The Contractor shall immediately remove for the duration of the Project, any person making an inappropriate racial, sexual, or ethnic comment, statement, joke, or gesture toward any other individual.

3.9.6. The Contractor shall immediately remove for the duration of the Project, any person who is incompetent, careless, disruptive, or not working in harmony with others.

3.10. CONSTRUCTION SCHEDULES

3.10.1. The Contractor shall, promptly after being awarded the Contract, prepare and submit for the Owner's and Architect/Engineer's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and per the requirements of the Contract Documents, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The Contractor's schedule shall be in the "Critical Path Method" and shall show the Critical Path of the Work in sufficient detail to evaluate the Contractor's progress. A request for time extension by the Contractor will not be allowed unless a change in the Work

is approved by the Owner and materially affects the Critical Path. It is the Contractor's responsibility to demonstrate that any time extensions requests materially affect the Critical Path.

3.10.2. The Contractor shall prepare and keep current, for the Architect/Engineer's approval, a schedule of submittals which is coordinated with the Contractor's Construction Schedule and allows the Architect/Engineer reasonable time to review submittals.

3.10.3. The Contractor shall perform the Work in accordance with the most recent schedule submitted to the Owner and Architect/Engineer.

3.10.4. The Contractor's operations (including but not limited to the Contractor's forces employed, sequences of operations, and methods of operation) at all times during the performance of the contract shall be: (a) subject to the review of the Owner or the Architect/Engineer; and, (b) sufficient to insure the completion of the Work within the specified performance period.

3.10.5. The Critical Path Method Construction Schedule prepared by the Contractor must be in a form that is acceptable to both the Architect/Engineer and the Owner.

3.10.5.1. The Schedule shall show the estimated progress of the entire Project through the individual time periods allowed for completion of each discipline, trade, phase, section, and aspect of the Work.

3.10.5.2. The Schedule shall show percent complete, progress to date, project work, and projected time to complete the work for all activities. The percent complete and minor schedule changes, including additions of activities, change orders, construction change directives, changes to sequences of activities and significant changes in activity demands must be shown by a revised Schedule. A written report providing details about the changes and what actions are anticipated to get the work completed in the contractual time period shall be submitted with the revised schedule.

3.10.5.3. The Construction Schedule shall include coordinate dates for performance of all divisions of the Work, including shipping and delivery, off-site requirements and tasks, so the Work can be completed in a timely and orderly fashion consistent with the required dates of Substantial Completion and Final Acceptance.

3.10.5.4. The Construction Schedule shall include: (i) the required commencement date, the required dates of Substantial Completion(s) and Final Acceptance for the complete Project and all phases (if any); (ii) any guideline and milestone dates required by the Owner or the Contract Documents; (iii) subcontractor and supplier schedules; (iv) a submittal schedule which allows sufficient time for review and action by the Architect/Engineer; (v) the complete sequence of all construction activities with start and completion dates; and, (vi) required decision dates.

3.10.5.5. By receiving, reviewing, and/or commenting on the Construction Schedule or any portion thereof (including logic and resource loading), neither the Owner or Architect/Engineer assume any of the Contractor's responsibility or liability that the Schedule be coordinated or complete, or for timely and orderly completion of the Work.

3.10.5.6. Receiving, reviewing, and/or commenting on the Schedule, any portion thereof, or any revision thereof, does not constitute an approval, acknowledgement, or acceptance of any duration, dates, milestones, or performance indicated therein.

3.10.5.7. A printout of the Schedule's logic showing all activities is required with the Schedule and with all updates to the Schedule.

3.10.6. The Contractor shall review and compare, at a minimum on a weekly basis, the actual status of the Work against its Construction Schedule.

3.10.7. The Contractor shall routinely, frequently, and periodically (but not less than monthly) update and/or revise its Construction Schedule to show actual progress of the Work through the date of the update or revision, projected level of completion of each remaining activity, activities modified since the previous

update or revision, and major changes in scope or logic. The updated/revised Schedule shall be accompanied by a narrative report which: (1) states and explains any modifications of the critical path, if any, including any changes in logic; (2) defines problem areas and lists areas of anticipated delays; (3) explains the anticipated impact the change in the critical path or problems and delays will have on the entire Schedule and the completion of the Work; (4) provides corrective action taken or proposed; and, (5) states how problems or delays will be resolved in order to deliver the Work by the required phasing milestones (if any), Substantial Completion(s), and Final Acceptance dates.

3.10.8. Delay in Performance: If at any time the Contractor anticipates that performance of the Work will be delayed or has been delayed, the Contractor shall: (1) immediately notify the Architect/Engineer by separate and distinct correspondence of the probable cause and effect of the delay, and possible alternatives to minimize the delay; and, (2) take all corrective action reasonably necessary to deliver the Work by the required dates. Nothing in this paragraph or the Contract Documents shall be construed by the Contractor as a granting by the Architect/Engineer or Owner of constructive acceleration. The results of failure to anticipate delays, or to timely notify the Owner and Architect/Engineer of an anticipated or real delay, are entirely the responsibility of the Contractor whether compensable or not.

3.10.9. Early Completion: The Contractor may attempt to achieve Substantial Completion(s) on or before the date(s) required in the Contract. However, such early completion shall be for the Contractor's sole convenience and shall not create any real or implied additional rights to Contractor or impose any additional obligations on the Owner or Architect/Engineer. The Owner will not be liable for nor pay any additional compensation of any kind to the Contractor for achieving Substantial Completion(s) or Final Acceptance prior to the required dates as set forth in the Contract. The Owner will not be liable for nor pay any additional compensation of any kind should there by any cause whatsoever that the Contractor is not able to achieve Substantial Completion(s) earlier than the contractually required dates of Substantial Completion(s) or Final Acceptance.

3.10.10. Float in Schedule. Any and all float time in the Contractor's schedule, regardless of the path or activity, shall accrue to the benefit of the Owner and the Work, and not to the Contractor. Float also includes any difference shown between any early completion dates shown on the Contractor's Schedule for any phasing milestone(s), Substantial Completion(s) or Final Acceptance and the dates or durations as required by the Contract Documents.

3.10.11. Modification of Required Substantial Completion(s) or Final Acceptance Dates: Modification of the required dates shall be accomplished only by duly authorized, accepted, and approved change orders stating the new date(s) with specificity on the change order form. All rights, duties, and obligations, including but not limited to the Contractor's liability for actual, delay, and/or liquidated damages, shall be determined in relation to the date(s) as modified.

3.11. DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE

3.11.1. The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and accurately marked to record current field changes and selections made during construction, and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect/Engineer or Owner at any time and shall be delivered to the Architect/Engineer for submittal to the Owner upon completion of the Work.

3.11.2. The Owner shall not be required to process final payment until all documentation and data required by the Contract Documents is submitted to and approved by the Architect/Engineer including, but not limited to, the As-Built Drawings. The Owner will not process any final request for payment until the Architect/Engineer has received and verified that the Contractor has performed the requirements pertaining to the as-built drawings.

3.11.3. The as-built drawings shall be neatly and clearly marked during construction to record all deviations, variations, changes, and alterations as they occur during construction along with such supplementary notes and details necessary to clearly and accurately represent the as-built condition. The as-built drawings shall be available at all times to the Owner, Architect/Engineer and Architect/Engineer's consultants.

3.12. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.1. Definitions:

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

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

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

3.12.2. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect/Engineer is subject to the limitations of Subparagraph 4.2.7. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

3.12.3. The Contractor shall review, approve, and submit to the Architect/Engineer, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents within sixty (60) calendar days of the project commencement date unless noted otherwise and shall do so in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Any and all items submitted by the Contractor which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor, or in the opinion of the Architect/Engineer, have not been reviewed for compliance by the Contractor even if marked as such, may be returned by the Architect/Engineer without action and shall not result in any accusation or claim for delay or cost by the Contractor. Any submittal that, in the opinion of the Architect/Engineer, is incomplete in any area or detail may be rejected and returned to the Contractor. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all submittals are complete, accurate, and in conformance to the Contract Documents prior to submission.

3.12.4. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents and guarantees to the Architect/Engineer and Owner that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

3.12.5. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer. Should the Contractor, Subcontractors or Sub-subcontractors install, construct, erect or perform any portion of the Work without approval of any requisite submittal, the Contractor shall bear the costs, responsibility, and delay for removal, replacement, and/or correction of any and all items, material, and /or labor.

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

3.12.7. The Contractor shall direct specific attention, in writing or on re-submitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect/Engineer on

previous submittals. In the absence of such written notice the Architect/Engineer's approval of a re-submission shall not apply to such revisions.

3.12.8. The Contractor shall not be required to provide professional services which constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect/Engineer will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect/Engineer. The Owner and the Architect/Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided the Owner and Architect/Engineer have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this subparagraph, the Architect/Engineer will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents but shall be responsible and held liable for review and verification of all performance or design criteria as required by Paragraph 3.2.

3.12.9. Unless noted otherwise in the Contract Documents, the Contractor shall submit to the Architect/Engineer within sixty (60) days from the date of project commencement electronic copies of all shop/setting drawings, schedules, cut sheets, products, product data, and samples required for the complete Work. Copies shall be reviewed, marked, stamped and approved on each and every copy by the Contractor prior to submission to the Architect/Engineer or they shall be returned without review or action. The Architect/Engineer shall review with reasonable promptness, making corrections, rejections, or other actions as appropriate. The Architect/Engineer’s approval or actions on shop/setting drawings, schedules, cut sheets, products, product data, or samples shall not relieve the Contractor from responsibility for, nor deviating from, the requirements of the plans and specifications. Any deviations from the plans and specifications requested or made by the Contractor shall be brought promptly to the attention of the Architect/Engineer.

3.12.10. Cost for Re-Submissions: the Contractor is responsible for ensuring that all shop drawings, product data, samples, and submittals contain all information required by the Contract Documents to allow the Architect/Engineer to take action. The costs and expenses to the Architect/Engineer for making exhaustive reviews of each Shop Drawing, Product Data item, sample, or submittal of the Contractor may be billed by the Architect/Engineer directly to the Contractor or, if otherwise agreed by the Owner in writing, may be reimbursed by the Owner to the Architect/Engineer and deducted from the Contractor’s contract via change order by the Owner. The Owner will not be liable to the Architect/Engineer for multiple reviews.

3.13. **USE OF SITE**

3.13.1. The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

3.13.2. The Contractor shall not damage, endanger, compromise or destroy any part of the Project or the site, including but not limited to work performed by others, monuments, stakes, bench marks, survey points, utilities, existing features or structures. The Contractor shall be fully and exclusively responsible for and bare all costs and delays (including and costs of delay) for any damage, endangerment, compromise, or destruction of any part of the Project or site.

3.14. **CUTTING AND PATCHING**

3.14.1. The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

3.14.2. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.15. CLEAN UP AND SITE CONTROL

3.15.1. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract during performance of the Work and at the direction of the Owner or Architect/Engineer. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

3.15.2. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.16. ACCESS TO WORK

3.16.1. The Contractor shall provide the Owner and Architect/Engineer access to the Work at all times wherever located.

3.17. ROYALTIES, PATENTS AND COPYRIGHTS

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

3.18. INDEMNIFICATION

3.18.1. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph. The Contractor agrees that it will defend, protect, indemnify and save harmless the State of Montana and the Owner against and from all claims, liabilities, demands, causes of action, judgments (including costs and reasonable attorneys' fees), and losses from any cause whatever (including patent, trademark and copyright infringement) except the Owner's sole or partial negligence. This includes any suits, claims, actions, losses, costs, damages of any kind, including the State and Owner's legal expenses, arising out of, in connection with, or incidental to the Contract, but does not include any such suits, claims, actions, losses, costs or damages which are the result of the negligent acts, actions, losses, costs, or damages which are acts, omissions or misconduct of the Owner if they do not arise out of, depend upon or relate to a negligent act, omission or misconduct of the Contractor in whole or in part.

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

ARTICLE 4 – ADMINISTRATION OF THE CONSTRUCTION CONTRACT

4.1. THE ARCHITECT/ENGINEER

4.1.1. The Architect/Engineer is the person lawfully licensed to practice or an entity lawfully practicing identified as such in the Agreement with the Owner and is referred to throughout the Contract Documents as if singular in number. The term “Architect/Engineer” means the Architect/Engineer’s duly authorized representative.

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

4.1.3. If the employment of the Architect/Engineer is terminated, the Owner shall employ a new Architect/Engineer at the sole choice and discretion of the Owner, whose status under the Contract Documents shall be that of the former Architect/Engineer.

4.2. ARCHITECT/ENGINEER’S ADMINISTRATION OF THE CONSTRUCTION CONTRACT

4.2.1. The Architect/Engineer will provide administration of the Contract as described in the Contract Documents, and will be an Owner's representative throughout the complete duration of the Project, including the warranty period. The Architect/Engineer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with the Architect/Engineer Contract.

4.2.2. The Architect/Engineer, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations to: (1) become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed; (2) endeavor to guard the Owner against defects and deficiencies in the Work; and, (3) to determine in general if the Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Owner and Architect/Engineer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Contractor’s Work. The Owner and Architect/Engineer will neither have control over or charge of, nor be responsible for, the construction means, methods, techniques, sequences or procedures, for the safety of any person involved in the work, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

4.2.3. The Architect/Engineer will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect/Engineer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

4.2.4. Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect/Engineer about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor to the Architect/Engineer. Communications by and with separate contractors shall be through the Owner to the Architect/Engineer.

4.2.5. Based on the Architect/Engineer's evaluations of the Contractor's Applications for Payment, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts. The Contractor is fully aware that the Owner (i.e. the State of Montana) has established a billing cycle for processing payments in Article 9 of these General Conditions. The

Contractor and all Subcontractors are subject to all provisions of Title 28, Chapter 2, Part 21 MCA regarding all aspects of the Work.

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

4.2.7. The Architect/Engineer will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect/Engineer's action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect/Engineer's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Paragraphs 3.3, 3.5 and 3.12. The Architect/Engineer's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

4.2.8. The Architect/Engineer will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Paragraph 7.4.

4.2.9. The Architect/Engineer will conduct inspections to determine the date or dates of Substantial Completion(s) and the date of Final Acceptance, will receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

4.2.10. If the Owner and Architect/Engineer agree, the Architect/Engineer will provide one or more project representatives to assist in carrying out the Architect/Engineer's responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in the Owner’s Agreement with the Architect/Engineer.

4.2.11. The Architect/Engineer will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor. The Architect/Engineer's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect/Engineer shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect/Engineer to furnish such interpretations until 15 days after written request is made for them.

4.2.12. Interpretations and decisions of the Architect/Engineer will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and initial decisions, the Architect/Engineer will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will render such interpretations and decisions in good faith.

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

4.2.14. The Architect/Engineer's or Owner's observations or inspections do not alleviate any responsibility on the part of the Contractor. The Architect/Engineer and the Owner reserves the right to observe and inspection the work and make comment. Action or lack of action following observation or inspection is not to be construed as approval of Contractor's performance.

4.3. CLAIMS AND DISPUTES

4.3.1. Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extensions of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes, controversies, and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest solely with the party making the Claim.

4.3.1.1. Time Limits on Claims. Claims by either party must be initiated within 21 calendar days after occurrence of the event giving rise to such claim. The following shall apply to the initiation of a claim:

4.3.1.1.1. A written notice of a claim must be provided to the Architect/Engineer and the other party within 21 calendar days after the occurrence of the event or the claim is waived by the claiming party and void in its entirety.

4.3.1.1.2. Claims must be initiated by separate, clear, and distinct written notice within the 21 calendar day time frame to the Architect/Engineer and the other party and must contain the notarized statement in Sub-Paragraph 4.3.1.5 when the claim is made by the Contractor. Discussions in any form with the Architect/Engineer or Owner, whether at the site or not, do not constitute initiation of a claim. Notes in project meeting minutes, email correspondence, change order proposals, or any other form of documentation does not constitute initiation of a claim. The written notice must be a separate and distinct correspondence provided in hardcopy to both the Architect/Engineer and Owner and must delineate the specific event and outline the causes and reasons for the claim whether or not cost or time have been fully determined. Written remarks or notes of a generic nature are invalid in their entirety. Comments made at progress meetings, project site visits, inspections, emails, voice mails, and other such communications do not meet the requirement of providing notice of claim.

4.3.1.1.3. Physical Injury or Physical Damage. Should the Owner or Contractor suffer physical injury or physical damage to person or property because of any error, omission, or act of the other party or others for whose acts the other party is legally and contractually liable, claim will be made in writing to the other party within a reasonable time of the first observance of such physical injury or physical damage but in no case beyond 30 calendar days of the first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose. In all such cases, the indemnification provisions of the Contract shall be effectual and the Contractor’s insurance shall be primary and in full effect.

4.3.1.2. All Claims must contain sufficient justification and substantiation with the written notice or they may be rejected without consideration by the Architect/Engineer or other party with no additional impact or consequence to the Contract Sum, Contract Time, or matter(s) in question in the Claim.

4.3.1.3. If additional compensation is claimed, the exact amount claimed and a breakdown of that amount into the following categories shall be provided with each and every claim:

4.3.1.3.1. Direct costs (as listed in Subparagraph 7.3.9.1 through 7.3.9.5);
4.3.1.3.2. Indirect costs (as defined in Paragraph 7.2.5); and,
4.3.1.3.3. Consequential items (i.e. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution) for the change.

4.3.1.4. If additional time is claimed the following shall be provided with each and every claim:

4.3.1.4.1. The specific number of days and specific dates for which the additional time is sought;

4.3.1.4.2. The specific reasons, causes, and/or effects whereby the Contractor believes that additional time should be granted; and,

4.3.1.4.3. The Contractor shall provide analyses, documentation, and justification of its claim for additional time in accordance with the latest Critical Path Method schedule in use at the time of event giving rise to the claim.

4.3.1.5. With each and every claim, the Contractor shall submit to the Architect/Engineer and Owner a notarized statement containing the following language:

"Under penalty of law (including perjury and/or false/fraudulent claims against the State), the undersigned,

_____, _____
(Name) (Title)

Of _____ _____
(Company) (Date)

hereby certifies, warrants, and guarantees that this claim made for Work on this Contract is a true statement of the costs, adjustments and/or time sought and is fully documented and supported under the contract between the parties.

_____, _____
(Signature) (Date)"

4.3.2. Continuing Contract Performance.

4.3.2.1. Pending final resolution of a Claim except as otherwise agreed in writing or as provided in Subparagraph 9.7.1 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents on the portion of the Work not involved in a Claim.

4.3.3. Claims for Cost or Time for Concealed or Unknown Conditions.

4.3.3.1. If conditions are encountered at the site which are: (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents; or, (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed.

4.3.3.2. The Architect/Engineer will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect/Engineer determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect/Engineer shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the date of the Architect/Engineer's decision.

4.3.3.3. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect/Engineer for initial determination, subject to further proceedings pursuant to Paragraph 4.4.

4.3.3.4. Nothing in this paragraph shall relieve the Contactor of its obligation to adequately and sufficiently investigate, research, and examine the site, the site survey, topographical information, and the geotechnical information available whether included by reference or fully incorporated in the Contract Documents.

4.3.4. Claims for Additional Cost.

4.3.4.1. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.6.

4.3.4.2. If the Contractor believes additional cost is involved for reasons including but not limited to: (1) a written interpretation from the Architect/Engineer; (2) an order by the Owner to stop the Work solely for the Owner's convenience or where the Contractor was not at least partially at fault; (3) a written order for a minor change in the Work issued by the Architect/Engineer; (4) failure of payment by the Owner per the terms of the Contract; (5) termination of the Contract by the Owner; or, (6) other reasonable grounds, Claim must be filed in accordance with this Paragraph 4.3.

4.3.5. Claims for Additional Time

4.3.5.1. If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as specified in these General Conditions shall be provided along with the notarized certification. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay for the same event or cause only one Claim is necessary. However, separate and distinct written notice is required for each separate event.

4.3.5.2. Weather Delays:

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

4.3.5.2.2. Inclement or adverse weather shall not be a prima facie reason for the granting of an extension of time, and the Contractor shall make every effort to continue work under prevailing conditions. The Owner may grant an extension of time if an unavoidable delay occurs as a result of inclement/severe/adverse weather and such shall then be classified as a "Delay Day". Any and all delay days granted by the Owner are and shall be non-compensable in any manner or form. The Contractor shall comply with the notice requirements concerning instances of inclement/severe/adverse weather before the Owner will consider a time extension. Each day of inclement/severe/adverse weather shall be considered a separate instance or event and as such, shall be subject to the notice requirements.

4.3.5.2.3. An "inclement", "severe", or "adverse" weather delay day is defined as a day on which the Contractor is prevented by weather or conditions caused by weather resulting immediately there from, which directly impact the current controlling critical-path operation or operations, and which prevent the Contractor from proceeding with at least 75% of the normal labor and equipment force engaged on such critical path operation or operations for at least 60% of the total daily time being currently spent on the controlling operation or operations.

4.3.5.2.4. The Contractor shall consider normal/typical/seasonal weather days and conditions caused by normal/typical/seasonal weather days for the location of the Work in the planning and scheduling of the Work to ensure completion within the Contract Time. No time extensions will be granted for the Contractor's failure to consider and account for such weather days and conditions caused by such weather for the Contract Time in which the Work is to be accomplished.

4.3.5.2.5. A “normal”, “typical”, or “seasonal” weather day shall be defined as weather that can be reasonably anticipated to occur at the location of the Work for each particular month involved in the Contract Time. Each month involved shall not be considered individually as it relates to claims for additional time due to inclement/adverse/severe weather but shall consider the entire Contract Time as it compares to normal/typical/seasonal weather that is reasonably anticipated to occur. Normal/typical/seasonal weather days shall be based upon U.S. National Weather Service climatic data for the location of the Work or the nearest location where such data is available.

4.3.5.2.6. The Contractor is solely responsible to document, prepare and present all data and justification for claiming a weather delay day. Any and all claims for weather delay days shall be tied directly to the current critical-path operation or operations on the day of the instance or event which shall be delineated and described on the Critical-Path Schedule and shall be provided with any and all claims. The Contractor is solely responsible to indicate and document why the weather delay day(s) claimed are beyond those weather days which are reasonably anticipated to occur for the Contract Time. Incomplete or inaccurate claims, as determined by the Architect/Engineer or Owner, may be returned without consideration or comment.

4.3.5.3. Where the Contractor is prevented from completing any part of the Work with specified durations or phases due to delay beyond the control of both the Owner and the Contractor, an extension of the contract time or phase duration in an equal amount to the time lost due to such delay shall be the Contractor’s sole and exclusive remedy for such delay.

4.3.5.4. Delays attributable to and/or within the control of subcontractors and suppliers are deemed to be within the control of the Contractor.

4.3.5.5. In no event shall the Owner be liable to the Contractor, any subcontractor, any supplier, Contractor’s surety, or any other person or organization, for damages or costs arising out of or resulting from: (1) delays caused by or within the control of the Contractor which include but are not limited to labor issues or labor strikes on the Project, federal, state, or local jurisdiction enforcement actions related directly to the Contractor’s Work (e.g. safety or code violations, etc.); or, (2) delays beyond the control of both parties including but not limited to fires, floods, earthquakes, abnormal weather conditions, acts of God, nationwide material shortages, actions or inaction by utility owners, emergency declarations by federal, state, or local officials enacted in the immediate vicinity of the project, or other contractors performing work for the Owner.

4.3.6. Claims for Consequential Damages

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

4.3.6.1.1. damages incurred by the Owner for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and,

4.3.6.1.2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, income, and for loss of profit.

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

4.4. RESOLUTION OF CLAIMS, DISPUTES, AND CONTROVERSIES

4.4.1. Decision of Architect/Engineer. Claims, including those alleging an error or omission by the Architect/Engineer, shall be referred initially to the Architect/Engineer for decision. A decision by the Architect/Engineer shall be required as a condition precedent to mediation, arbitration or litigation of all

Claims between the Contractor and Owner arising prior to the date of Final Acceptance, unless 30 days have passed after the Claim has been referred to the Architect/Engineer with no decision having been rendered by the Architect/Engineer. The Architect/Engineer will not decide disputes between the Contractor and persons or entities other than the Owner. Any Claim arising out of or related to the Contract, except those already waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, pending compliance with Subparagraph 4.4.5, be subject to mediation, arbitration, or the institution of legal or equitable proceedings. Claims waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4, and 9.10.5 are deemed settled, resolved, and completed.

4.4.2. The Architect/Engineer will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party; (2) reject the Claim in whole or in part; (3) approve the Claim; (4) suggest a compromise; or (5) advise the parties that the Architect/Engineer is unable to resolve the Claim if the Architect/Engineer lacks sufficient information to evaluate the merits of the Claim or if the Architect/Engineer concludes that, in the Architect/Engineer's sole discretion, it would be inappropriate for the Architect/Engineer to resolve the Claim.

4.4.3. If the Architect/Engineer requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond within ten (10) days after receipt of such request and shall either provide a response on the requested supporting data, advise the Architect/Engineer when the response or supporting data will be furnished, or advise the Architect/Engineer that no supporting data will be furnished. Upon either no response or receipt of the response or supporting data, the Architect/Engineer will either reject or approve the Claim in whole or in part.

4.4.4. The Architect/Engineer will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect/Engineer shall be final and binding on the parties but subject to mediation and arbitration.

4.4.5. When 30 days have passed upon submission of a Claim without decision or action by the Architect/Engineer, or the Architect/Engineer has rendered a decision or taken any of the actions identified in Subparagraph 4.4.2, a demand for arbitration of a Claim covered by such decision or action must be made within 30 days after the date of expiration of Subparagraph 4.4.1 or within 30 days of the Architect/Engineer’s decision or action. Failure to demand arbitration within said 30 day period shall result in the Architect/Engineer's decision becoming final and binding upon the Owner and Contractor whenever such decision is rendered.

4.4.6. If the Architect/Engineer renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.

4.4.7. Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

4.4.8. A Claim subject to or related to liens or bonds shall be governed by applicable law regarding notices, filing deadlines, and resolution of such Claim prior to any resolution of such Claim by the Architect/Engineer, by mediation, or by arbitration, except for claims made by the Owner against the Contractor’s bonds.

4.5. **MEDIATION**

4.5.1. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, after initial decision by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.

4.5.2. The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect and/or those rules specified in the contract documents or separately agreed upon between the parties. Construction Industry Mediation Rule M-2 (filing with AAA) is void. The parties shall mutually agree upon a mediator who shall then take the place of AAA in the Construction Industry Mediation Rules. The parties must mutually agree to use AAA and no filing of a request for mediation shall be made to AAA by either party until such mutual agreement has been made. Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association. The request may be made concurrently with the filing of a demand for arbitration but, in such event, mediation shall proceed in advance of arbitration or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

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

4.6. **ARBITRATION**

4.6.1. Any controversy or Claim arising out of or related to this Contract or the breach thereof shall be settled by arbitration in accordance with the Montana Uniform Arbitration Act (MUAA). To the extent it does not conflict with the MUAA, the Construction Industry Arbitration Rules of the American Arbitration Association shall apply except as modified herein. The parties to the arbitration shall bear their own costs and expenses for participating in the arbitration. Costs of the Arbitration panel shall be borne equally between the parties except those costs awarded by the Arbitration panel (including costs for the arbitration itself).

4.6.2. Prior to the arbitration hearing all parties to the arbitration may conduct discovery subject to the provisions of Montana Rules of Civil Procedure. The arbitration panel may award actual damages incurred if a party fails to provide full disclosure under any discovery request. If a party claims a right of information privilege protected by law, the party must submit that claim to the arbitration panel for a ruling, before failing to provide information requested under discovery or the arbitration panel may award actual damages.

4.6.3. The venue for all arbitration proceedings required by this Contract shall be the seat of the county in which the work occurs or the First Judicial District, Lewis & Clack County, as determined solely by the Owner. Arbitration shall be conducted by a panel comprised of three members with one selected by the Contractor, one selected by the Owner, and one selected by mutual agreement of the Owner and the Contractor.

4.6.4. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5, shall, after decision or action by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to arbitration provided a demand for arbitration is made within the time frame provided in Subparagraph 4.4.5. If such demand is not made with the specified time frame, the Architect/Engineer's decision or action is final. Prior to arbitration, the parties shall endeavor to resolve disputes by mediation in accordance with the provisions of Paragraph 4.5.

4.6.5. Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect and/or those rules specified in the Contract Documents or separately agreed upon between the parties. Construction Industry Arbitration Rule R-3 (filing with AAA) is void. The parties shall mutually agree upon an arbitrator or arbitrators who shall then take the place of AAA in the Construction Industry Arbitration Rules. The parties must mutually agree to use AAA and no filing of a demand for arbitration shall be made to AAA by either party until such mutual agreement has been made. The demand for arbitration shall be filed in writing with the other party to the Contract and a copy shall be filed with the Architect/Engineer.

4.6.6. A demand for arbitration shall be made within the time limits specified in Subparagraphs 4.4.5 and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Paragraph 13.7.

4.6.7. Pending final resolution of a Claim including arbitration, unless otherwise mutually agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract on Work or amounts not in dispute.

4.6.8. **Limitation on Consolidation or Joinder**. Arbitration arising out of or relating to the Contract may include by consolidation or joinder the Architect/Engineer, the Architect/Engineer's employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Architect/Engineer, Owner, Contractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Architect/Engineer, Contractor, a separate contractor as described in Article 6 and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Architect/Engineer, Contractor or a separate contractor as described in Article 6 shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

4.6.9. **Claims and Timely Assertion of Claims**. The party filing a demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

4.6.10. **Judgment on Final Award**. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof. The parties agree that the costs of the arbitrator(s') compensation and expenses shall be borne equally. The parties further agree that the arbitrator(s) shall have authority to award to either party some or all of the costs and expenses involved, including attorney's fees.

ARTICLE 5 – SUBCONTRACTORS

5.1. DEFINITIONS

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

5.2. AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1. Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract and in no instance later than (30) days after award of the Contract, shall furnish in writing to the Owner through the Architect/Engineer the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect/Engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect/Engineer, after due investigation, has reasonable objection to any such proposed person or entity.

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

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

5.2.4. The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect/Engineer makes reasonable objection to such substitute. The Contractor shall not change or substitute for a Subcontractor who was required to be listed on the bid without first getting the approval of the Owner.

5.2.5. Buy-Safe Montana Provision: Before commencement of each subcontractor's portion of the Work, the Contractor shall obtain each subcontractor's incidence rate, experience modification rate, and loss ratio. The Contractor shall endeavor--but is not required--to use subcontractors whose incidence rate is less than the latest average for non-residential building construction for Montana as established by the Federal Bureau of Labor Statistics for the prior year; whose experience modification rating (EMR) is less than 1.0; and whose loss ratio is less than 100%. Contractor shall require any of its subcontractors who, based on the safety information that the Contractor obtains, have greater-than-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100%, to schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before substantial completion of each such subcontractor's portion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit http://erd.dli.mt.gov/safety-health/onsite-consultation.

5.3. SUBCONTRACTUAL RELATIONS

5.3.1. By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect/Engineer. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect/Engineer under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement which may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

5.3.2. Upon written request by the Owner, the Contractor shall require its subcontractors to provide to it performance and payment securities for their portion of the Work in the types and form defined in statute (18-2-201 and 18-2-203 MCA) for all sub-contractual agreements.

5.3.3. The Contractor shall prepare a Subcontractors' and Suppliers' chart in CSI division format acceptable to the Owner which lists by name, all contact information, job category, and responsibility the Contractor's Subcontractors (at all tiers or levels) and Suppliers with a pecuniary interest in the Project of greater than $5,000.00. The Contractor shall not enter into any agreement with any subcontractor or supplier to which the Owner raises a timely objection. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference but no less than 30 days after award of the Contract.

5.3.4. All Contractors and Subcontractors to this contract must comply with all Montana Department of Labor and Industry requirements, regulations, rules, and statutes.

5.3.5. In accordance with 39-51-1104 MCA, any Contractor who is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, who contracts with any Subcontractor who also is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code

Annotated, shall withhold sufficient money on the contract to guarantee that all taxes, penalties, and interest are paid upon completion of the contract.

5.3.5.1. It is the duty of any Subcontractor who is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, to furnish the Contractor with a certification issued by the Montana Department of Labor and Industry, prior to final payment stating that said Subcontractor is current and in full compliance with the provisions of Montana Department of Labor and Industry.

5.3.5.2. Failure to comply shall render the Contractor directly liable for all taxes, penalties, and interest due from the Subcontractor, and the Montana Department of Labor and Industry has all of the remedies of collection against the Contractor under the provisions of Title 39, Chapter 51 of Montana Code Annotated, as though the services in question were performed directly for the Contractor.

5.3.6. In compliance with state statutes (15-50-206 MCA), the Contractor will have the 1% Gross Receipts Tax withheld from all payments. Each "Public Contractor" includes all Subcontractors with contracts greater than $80,000 each. The Contractor and all Subcontractors will withhold said 1% from payments made to all Subcontractors with contracts greater than $80,000.00 and make it payable to the Montana Department of Revenue. The Contractor and all Subcontractors shall also submit documentation of all contracts greater than $80,000.00 to the Montana Department of Revenue on the Department's prescribed form.

5.3.7. Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

5.4. CONTINGENT ASSIGNMENT OF SUBCONTRACTS

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

5.4.1.1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Paragraph 14.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor and Contractor in writing; and,

5.4.1.2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

5.4.2. Upon such assignment, if the Work has been suspended for more than 30 days as a result of the Contractor's default, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension. Such adjustment shall be at the expense of the Contractor.

5.4.3. The Contractor shall engage each of its subcontractors and suppliers with written contracts that preserve and protect the rights of the Owner and include the acknowledgement and agreement of each subcontractor and supplier that the Owner is a third-party beneficiary of their sub-contractual and supplier agreements. The Contractor's agreements shall require that in the event of default by the Contractor or termination of the Contractor, and upon request of the Owner, the Contractor's subcontractors and suppliers will perform services for the Owner.

5.4.4. Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1. OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Paragraph 4.3.

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

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

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

6.2. MUTUAL RESPONSIBILITY

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

6.2.2. If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect/Engineer apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

6.2.3. The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

6.2.4. The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Paragraph 12.2.

6.2.5. The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Subparagraph 3.14.

6.3. OWNER'S RIGHT TO CLEAN UP

6.3.1. If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste

materials and rubbish, the Owner may clean up and the Architect/Engineer will determine the responsibility of those involved and allocate the cost accordingly.

ARTICLE 7 – CHANGES IN THE WORK

7.1. GENERAL

7.1.1. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive, or order for a minor change in the Work subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Minor changes as ordered by the Architect/Engineer has the definition provided in Paragraph 7.4

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

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

7.1.4. No act, omission, or course of dealing, shall alter the requirement that Change Orders or Construction Change Directives shall be in writing and signed by the Owner, and that Change Orders and Construction Change Directives are the exclusive method for effecting any adjustment to the Contract. The Contractor understands and agrees that neither the Contract Sum nor the Contract Time can be changed by implication, oral agreement, verbal directive, or unsigned Change Order.

7.2. CHANGE ORDERS

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

7.2.1.1. change in the Work;

7.2.1.2. the amount of the adjustment, if any, in the Contract Sum; and,

7.2.1.3. the extent of the adjustment, if any, in the Contract Time.

7.2.2. The cost or credit to the Owner resulting from a change in the Work shall be determined as follows:

7.2.2.1. Per the limitations of this Subparagraph, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive; or,

7.2.2.2. By one of the methods in Subparagraph 7.3.4, or as determined by the Architect/Engineer per Subparagraph 7.3.9, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive.

7.2.2.3. The Contractor’s proposed increase or decrease in cost shall be limited to costs listed in Subparagraph 7.3.9.1 through 7.3.9.5.

7.2.3. The Contractor shall not submit any Change Order, response to requested cost proposals, or requested changes which are incomplete and do not contain full breakdown and supporting documentation in the following three areas:

7.2.3.1. Direct costs (only those listed in Subparagraph 7.3.9.1 through 7.3.9.5 are allowable);

7.2.3.2. Indirect costs (limited as a percentage on each Change Order per Paragraph 7.2.2); and

7.2.3.3. Consequential items (e.g. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution).

7.2.4. Any Change Order, responses to requested proposals, or requested changes submitted by the Contractor which, in the opinion of the Architect/Engineer, are incomplete, may be rejected and returned to the Contractor without comment. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all Change Orders, responses to requested proposals, or requested changes are complete prior to submission.

7.2.5. Overhead, applicable to all areas and sections of the Contract Documents, means "Indirect Costs" as referenced in Subparagraph 7.2.3.2. Indirect costs are inclusive of, but not limited to, the following: home office overhead; off-site supervision; home office project management; change order and/or proposal preparation, design, research, negotiation and associated travel; effects of disruption and dilution of management and supervision off-site; time delays; coordination of trades; postage and shipping; and, effective increase in guarantee and warranty durations. Indirect costs applicable to any and all changes in the work, either through Change Order or Construction Change Directive, are limited to the percentage allowance for overhead in Subparagraph 7.2.2.

7.2.6. By signature on any Change Order, the Contractor certifies that the signed Change Order is complete and includes all direct costs, indirect costs and consequential items (including additional time, if any) and is free and clear of all claims or disputes (including, but not limited to, claims for additional costs, additional time, disruptions, and/or impacts) in favor of the Contractor, subcontractors, material suppliers, or other persons or entities concerning the signed change order and on all previously contracted Work and does release the Owner from such claims or demands.

7.2.7. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Change Order shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes which affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time, shall not result in an increase in the Contract Time.

7.2.8. Supervision means on-site, field supervision and not home office overhead, off-site management or off-site supervision.

7.2.9. Labor means those persons engaged in construction occupations as defined in Montana Prevailing Wage Rates for Building Construction or Heavy/Highway as bound in the Contract Documents and does not include design, engineering, superintendence, management, on-site field supervision, home office or other off-site management, off-site supervision, office or clerical work.

7.3. CONSTRUCTION CHANGE DIRECTIVES

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

7.3.2. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Construction Change Directive, shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes that affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time shall not result in an increase in the Contract Time.

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

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

7.3.4.1. mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

7.3.4.2. unit prices stated in the Contract Documents or subsequently agreed upon;

7.3.4.3. cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee;

7.3.4.4. By actual cost as shown by the Contractor's and Subcontractor's itemized invoices; or

7.3.4.5. as provided in Subparagraph 7.3.9.

7.3.5. Costs shall be limited to the following: cost of materials, including cost of delivery; cost of labor, including social security, old age and unemployment insurance and fringe benefits under collective bargaining agreements; workers' compensation insurance; bond premiums; and rental value of power tools and equipment.

7.3.6. Overhead and profit allowances shall be limited on all Construction Change Directives to those identified in 7.2.2.

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

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

7.3.9. If the Contractor does not respond or disagrees with the method for adjustment in the Contract Sum in writing within seven (7) calendar days, the method and the adjustment made shall be determined by the Architect/Engineer on the basis of reasonable expenditures and/or savings of those performing the Work directly attributable to the change including, in the case of an increase in the Contract Sum, plus an allowance for overhead and profit as listed under Subparagraph 7.2.2. In such case, and also under Clause 7.3.4.3, the Contractor shall keep and present, in such form as the Architect/Engineer may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 7.3.9 shall be limited to the following:

7.3.9.1. costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance as determined by the Prevailing Wage Schedules referenced in the Contract Documents;

7.3.9.2. costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;

7.3.9.3. rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

7.3.9.4. costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and

7.3.9.5. additional costs of field supervision and field office personnel directly attributable to the change.

7.3.10. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect/Engineer

plus markups in subparagraph 7.2.2. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net change, if any, with respect to that change.

7.3.11. Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by a Change Order indicating the parties' agreement with part or all of such costs. For any portion of such cost that remains in dispute, the Architect/Engineer will make an interim determination for purposes of monthly certification for payment for those costs. That determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a claim in accordance with Article 4.

7.3.12. When the Owner and Contractor agree with the determination made by the Architect/Engineer concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

7.4. **MINOR CHANGES IN THE WORK**

7.4.1. The Architect/Engineer will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

ARTICLE 8 – TIME

8.1. **DEFINITIONS**

8.1.1. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day shall be determined as the day following the current day of any event or notice starting a specified duration.

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

8.1.3. The date of commencement of the Work is the date established in ARTICLE 2 OF THE CONTRACT AS ISSUED BY THE OWNER.

8.1.4. The date the Contractor reaches Substantial Completion is the date certified by the Architect/Engineer in accordance with Paragraph 9.8.

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

8.1.6. Liquidated Damages. The Owner may suffer loss if the project is not substantially complete on the date set forth in the contract documents. The Contractor and his surety shall be liable for and shall pay to the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay until the work is substantially complete: As indicated in the Instructions to Bidders document and/or Contract.

8.1.7. The Contractor shall not be charged liquidated or actual damages when delay in completion of the Work is due to:

8.1.7.1. Any preference, priority or allocation order issued by the government;

8.1.7.2. Unforeseeable cause beyond the control and without the fault or negligence of the Contractor, such as acts of God or of the public enemy, fires, floods, epidemics, quarantine restrictions, freight embargoes, and unusually severe weather. All such occurrences resulting in delay must be documented and approved by Change Order; or,

8.1.7.3. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in 8.1.7.1 and 8.1.7.2 of this article.

8.1.8. The Contractor is completely obligated and responsible to provide written notice of each day of delay as provided for in Paragraph 4.3.

8.1.9. Contract Time. All work shall reach Substantial Completion within or by: Dates provided in Instructions to Bidders and Invitation to Bid documents. The Owner will issue a Contract for Construction with the specified dates of commencement and completion.

8.2. PROGRESS AND COMPLETION

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

8.2.2. The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the date in the Contract and in no case prior to the effective date of insurance required by Article 11 to be furnished by the Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance.

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

8.2.4. If the Contractor falls behind the latest construction schedule by more than 14 calendar days through its own actions or inaction, neglect, inexperience, lack of oversight and management of the Work including that of any Subcontractors, written notice to the Owner and Architect/Engineer shall be provided within three (3) days with explanation of how the Contractor intends to get back on schedule. Response to getting back on schedule consists of providing a sufficient number of qualified workers and/or proper materials or an acceptably reorganized schedule to regain the lost time in a manner acceptable to the Owner.

8.3. DELAYS AND EXTENSIONS OF TIME

8.3.1. If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect/Engineer, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending mediation and arbitration, or by other causes which the Architect/Engineer determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect/Engineer may determine.

8.3.2. Claims relating to time shall be made in accordance with applicable provisions of Paragraph 4.3.

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

PAYMENTS AND COMPLETION

9.1. CONTRACT SUM

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

9.2. SCHEDULE OF VALUES

9.2.1. Before the first Application for Payment, the Contractor shall submit to the Architect/Engineer a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect/Engineer may require. This schedule, unless objected to by the Architect/Engineer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

9.3. **APPLICATIONS FOR PAYMENT**

9.3.1. The Contractor shall submit to the Architect/Engineer an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be signed and supported by such data substantiating the Contractor's right to payment as the Owner or Architect/Engineer may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

9.3.2. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a Contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.

9.3.3. As provided in Subparagraph 7.3.11, such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives, or by interim determinations of the Architect/Engineer, but not yet included in Change Orders.

9.3.4. Applications for payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

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

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

9.3.7. Until the work is complete, the Owner will pay 95% of the amount due the Contractor on account of progress payments.

9.3.7.1. If the Work and its progress are not in accordance with all or any part, piece, or portion of the Contract Documents, the Owner may, at its sole discretion and without claim by the Contractor, increase the amount held as retainage to whatever level deemed necessary to effectuate performance and progress of the Work, for anticipated repairs, warranties or completion of the Work by the Contractor or through the letting of other contracts. The Contractor will not be entitled to additional costs, expenses, fees, time, and such like, in the event the Owner increases the amount held as retainage due to non-compliance and/or non-performance with all or any part, piece, or portion of the Contract Documents.

9.3.7.2. Prior to the first application for payment, the Contractor shall submit the following information on the appropriate forms:

9.3.7.2.1. Schedule of Amounts for Contract Payment (Form 100): This form shall contain a breakdown of the labor, material and other costs associated with the various portions of the work and shall be the basis for the progress payments to the Contractor. The use of electronic method shall be in the Owner's format.

9.3.7.2.2. Project/Progress Schedule: If no Schedule (or revised Schedule) is provided with each and every Periodic Estimates for Partial Payment, the Architect/Engineer and/or Owner may return the pay request, or hold it, and may choose not pay for

any portion of the Work until the appropriate Schedule, indicating all changes, revisions and updates, is provided. No claim for additional costs or interests will be made by the Contractor or any subcontractor on account of holding or non-payment of the Periodic Estimate for Partial Payment request.

9.3.7.3. Progress Payments

9.3.7.3.1. Periodic Estimates for Partial Payment shall be on a form provided by the Owner (Form 101) and submitted to the Architect/Engineer for payment by the Owner. Payment shall be requested for the labor and material incorporated in the work to date and for materials suitably stored, less the aggregate of previous payments, the retainage, and the 1% gross receipts tax.

9.3.7.3.2. The Contractor, by submission of any partial pay request, certifies that every request for partial payment is correct, true and just in all respects and that payment or credit had not previously been received. The Contractor further warrants and certifies, by submission of any partial pay request, that all previous work for which payment has been received is free and clear of all liens, disputes, claims, security interests, encumbrances, or causes of action of any type or kind in favor of the Contractor, subcontractors, material suppliers or other persons or entities and does release the Owner from such.

9.3.7.3.3. Progress payments do not constitute official acceptance of any portion of the work or materials whether stored on or off-site.

9.3.7.3.4. In compliance with 15-50-206 MCA, the Contractor will have 1% of his gross receipts withheld by the Owner from all payments due. Each subcontractor who performs work greater than $80,000 shall have 1% of its gross receipts withheld by the Contractor. The Contractor shall notify the Department of Revenue on the department's prescribed forms.

9.3.7.4. The Contractor may submit obligations/securities in a form specified in 18-1-301 Montana Code Annotated (MCA) to be held by a Financial Institution in lieu of retainage by the Owner. The Owner will establish the amount that would otherwise be held as retainage. Should the Contractor choose to submit obligations/securities in lieu of retainage, the Owner will require the Financial Institution to execute the Owner's "Account Agreement for Deposit of Obligations Other Than Retainage" (Form 120) prior to submission of any obligations/securities in accordance with 18-1-302 MCA. The Contractor must extend the opportunity to participate in all obligations/securities in lieu of retainage on a pro rata basis to all subcontractors involved in the project and shall be solely responsible for the management and administration of same. The Owner assumes no liability or responsibility from or to the Contractor or Subcontractors regarding the latter's participation.

9.3.7.5. The Contractor shall maintain a monthly billing cycle.

9.4. CERTIFICATES FOR PAYMENT

9.4.1. The Architect/Engineer will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect/Engineer determines is properly due, or notify the Contractor and Owner in writing of the Architect/Engineer's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1. For the purposes of this paragraph regarding certification of payment, electronic mail and/or notes provided through the use of an electronic approval system shall constitute written notice.

9.4.2. The issuance of a Certificate for Payment will constitute a representation by the Architect/Engineer to the Owner, based on the Architect/Engineer's evaluation of the Work and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect/Engineer's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect/Engineer. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified.

However, the issuance of a Certificate for Payment will not be a representation that the Architect/Engineer has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or, (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

9.5. **DECISIONS TO WITHHOLD CERTIFICATION**

9.5.1. The Architect/Engineer may withhold or reject a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect/Engineer's opinion the representations to the Owner required by Subparagraph 9.4.2 cannot be made. If the Architect/Engineer is unable to certify payment in the amount of the Application, the Architect/Engineer will notify the Contractor and Owner as provided in Subparagraph 9.4.1. If the Contractor and Architect/Engineer cannot agree on a revised amount, the Architect/Engineer will promptly issue a Certificate for Payment for the amount for which the Architect/Engineer is able to make such representations to the Owner. The Architect/Engineer may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect/Engineer's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Subparagraph 3.3.4, because of:

9.5.1.1. defective Work not remedied;

9.5.1.2. third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;

9.5.1.3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

9.5.1.4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

9.5.1.5. damage to the Owner or another contractor;

9.5.1.6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or,

9.5.1.7. persistent failure to carry out the Work in accordance with the Contract Documents.

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

9.5.3. Owner’s Right to Refuse Payment: The Architect/Engineer’s approval, or partial approval, of the Contractor’s request for payment shall not preclude or prevent the Owner from exercising any of its remedies under this Contract. The Owner shall have right to refuse to make payment(s) to the Contractor due to:

9.5.3.1. the Contractor’s failure to perform the Work in compliance with the Contract Documents;

9.5.3.2. the Contractor’s failure to correct any defective or damaged Work;

9.5.3.3. the Contractor’s failure to accurately represent the Work performed in the pay request;

9.5.3.4. the Contractor’s performance of its Work at a rate or in a manner that, in the Owner’s opinion, is likely to result in the Work, or any portion thereof, to be delayed;

9.5.3.5. the Contractor’s failure to use funds previously paid to it by the Owner to pay for the Contractor’s Work-related obligations including, but not limited to, subcontractors and suppliers on this Project;

9.5.3.6. claims made, or anticipated by the Owner to be made, against the Owner or its property;

9.5.3.7. inclusion in the pay request of any amounts in dispute or part of a claim;

9.5.3.8. Damage or loss caused by the Contractor, including its subcontractors and suppliers; or,

9.5.3.9. The Contractor's failure or refusal to perform its obligations to the Owner.

9.6. PROGRESS PAYMENTS

9.6.1. After the Architect/Engineer has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents or the Owner may take any action the Owner deems necessary under Subparagraph 9.5.3.

9.6.2. The Contractor shall promptly pay each Subcontractor in accordance with Title 28, Chapter 2, Part 21, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

9.6.3. The Contractor is prohibited from holding higher amounts in retainage on any Subcontractor than the Owner is holding from the Contractor.

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

9.6.5. Neither the Owner nor Architect/Engineer shall have an obligation to pay, or to see to the payment of, money to a Subcontractor except as may otherwise be required by law.

9.6.6. Payment to material suppliers shall be treated in a manner similar to that provided in Subparagraphs 9.6.2, 9.6.3, 9.6.4, and 9.6.5.

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

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

9.7. FAILURE OF PAYMENT

9.7.1. If the Owner does not approve payment to the Contractor within thirty-five (35) calendar days after the receipt of a certified Application for Payment, then the Contractor may, upon seven additional days' written notice to the Owner and Architect/Engineer, suspend the Work until payment of the amount owing has been received. Nothing in the Subparagraph shall limit the Owner's rights and options as provided in Subparagraph 9.5.3. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

9.8. SUBSTANTIAL COMPLETION

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

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

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

9.8.4. The Contractor shall ensure the project is substantially complete prior to requesting any inspection by the Architect/Engineer so that no more than one (1) inspection is necessary to determine Substantial Completion for all or any portion of the Work. If the Contractor does not perform adequate inspections to develop a comprehensive list as required in Subparagraph 9.8.2 and does not complete or correct such items upon discovery or notification, the Contractor shall be responsible and pay for the costs of the Architect/Engineer’s additional inspections to determine Substantial Completion.

9.8.5. When the Work or designated portion thereof is substantially complete, the Architect/Engineer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion and which shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance. After issuance of the Certificate of Substantial Completion, the Contractor shall finish and complete all remaining items within thirty (30) calendar days of the date on the Certificate. The Architect/Engineer shall identify and fix the time for completion of specific items which may be excluded from the thirty (30) calendar day time limit. Failure to complete any items within the specified time frames may be deemed by the Owner as default of the contract on the part of the Contractor.

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

9.9. PARTIAL OCCUPANCY OR USE

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

9.9.2. Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect/Engineer shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions

of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

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

9.10. FINAL COMPLETION AND FINAL PAYMENT

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

9.10.2. Neither final payment nor any remaining retainage shall become due until the Contractor submits to the Architect/Engineer:

9.10.2.1. completed Contractor's Affidavit of Completion, Payment of Debts and Claims, and Release of Liens (Form 106) that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied;

9.10.2.2. a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner;

9.10.2.3. a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents

9.10.2.4. Consent of Surety Company to Final Payment (Form 103); and,

9.10.2.5. if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.

9.10.3. The Contractor and his surety accepts and assumes responsibility, liability, and costs for and agrees to defend and hold harmless the Owner for and against any and all actions as a result of the Owner making final payment.

9.10.4. By submitting any Application for Payment to the Architect/Engineer the Contractor and his surety certify and declare that all bills for materials, supplies, utilities and for all other things furnished or caused to be furnished by the Contractor and all Subcontractors and used in the execution of the Contract will be fully paid upon receipt of Final Payment and that there are no unpaid obligations, liens, claims, security interests, encumbrances, liabilities and/or demands of State Agencies, subcontractors, suppliers, mechanics, laborers or any others resulting from or arising out of any work done, caused to be done or ordered to be done by the Contractor under the contract.

9.10.5. In consideration of the prior payments and the final payment made and all payments made for authorized changes, the Contractor releases and forever discharges the Owner from any and all obligations, liens, claims, security interests, encumbrances and/or liabilities arising by virtue of the contract and authorized changes between the parties, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the Owner, arising out of or in any way relating to the contract and authorized changes.

9.10.6. The date of Final Payment by the Owner shall constitute Final Acceptance of the Work. The determining date for the expiration of the warranty period shall be as specified in Paragraphs 3.5 and 12.2.2.

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

9.10.8. The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

9.10.8.1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

9.10.8.2. failure of the Work to comply with the requirements of the Contract Documents; or,

9.10.8.3. terms of special warranties required by the Contract Documents.

9.10.9. Acceptance of final payment by the Contractor, a Subcontractor, or material supplier, shall constitute a waiver of any and all obligations, liens, claims, security interests, encumbrances and/or liabilities against the Owner except those previously made in writing per the requirements of Paragraph 4.3 and as yet unsettled at the time of submission of the final Application for Payment.

9.10.10. The Owner's issuance of Final Payment does not constitute a waiver or release of any kind regarding any past, current, or future claim the Owner may have against the Contractor and/or the surety.

ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY

10.1. SAFETY

10.1.1. **Importance of Safety**. The Contractor and all Subcontractors (at any tier or level) recognize that safety is paramount at all times. The Contractor shall perform the work in a safe manner with the highest regard for safety of its employees and all other individuals and property at the work site. Contractor shall maintain its tools, equipment, and vehicles in a safe operating condition and take all other actions necessary to provide a safe working environment for performance of work required under this Contract. The Contractor is solely responsible for the means, methods, techniques, sequences and procedures for coordinating and constructing the Work, including all site safety, safety precautions, safety programs, and safety compliance with OSHA and all other governing bodies.

10.1.2. **Particular Safeguards**. (a). The Contractor shall erect and maintain, as required by Paragraphs 10.1.1 and 10.1.3, safeguards for safety and protection, including posting danger signs and other warnings against hazards, installing suitable barriers and lighting, promulgating safety regulations, and providing notification to all parties who may be impacted by the Contractor's operations. (b) When use or storage of explosives or other Hazardous Materials/Substances (defined below) or equipment are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. (c) The Contractor shall not encumber or load or permit any part of the construction site to be encumbered or loaded so as to endanger the safety of any person(s).

10.1.3. **Compliance with Safety Laws**. Contractor represents and warrants to Owner that it knows and understands all federal, state and local safety statutes, rules, and regulations (Laws) related to the work under this Contract. Contractor shall comply with these Laws. Contractor shall keep all material data safety sheets on site and available at all times.

10.1.4. **Remedy property damage**. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor of any tier or level, or anyone employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible. The

foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.18.

10.1.5. **Designation of Safety Representative.** Unless the Contractor designates, in writing to the Owner and the Architect/Engineer, another responsible member of the Contractor's organization as the Safety Representative, the Contractor's superintendent is the Safety Representative. The Safety Representative is defined as that member of the Contractor's organization responsible for all safety under this Contract.

10.1.6. **Release/Indemnity of Owner and Architect/Engineer**. The Contractor agrees that the Owner and Architect/Engineer are not responsible for safety at the work site and releases them from all obligations and liability regarding safety at the work site The Contractor shall indemnify and defend the Owner and the Architect/Engineer against and from all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses (including but not limited to court costs and reasonable attorney fees), arising from injuries and death to any persons and damage to real and personal property arising from, in connection with, or incidental to Contractor's safety responsibilities under this Contract.

10.2. **HAZARDOUS MATERIALS/SUBSTANCES**

10.2.1. "Hazardous Materials/Substances" means any substance: (a) the presence of which requires investigation, or remediation under any federal, state or local statute, rule, regulation, ordinance, order, policy or common law; (b) that is or becomes defined as "hazardous waste," "hazardous substance," pollutant, or contaminant under any federal, state or local statute, rule, regulation, or ordinance or amendments thereto; (c) that is toxic, explosive, corrosive flammable, or otherwise hazardous and is or becomes regulated by any government authority, agency, board, commission or instrumentality of the United States, the state of Montana or any political subdivision thereof; (d) gasoline, diesel fuel or other petroleum hydrocarbons; (e) containing contains polychlorinated biphenyls (PCBs) or asbestos; or (f) the presence of which causes or threatens to cause a nuisance or trespass on the work site or adjacent property.

10.2.2. The Contractor is solely responsible for all compliance with all regulations, requirements, and procedures governing Hazardous Materials/Substances at the Work Site or that Contractor brings on the site. The Contractor is solely responsible for remediation, costs, damages, loss, and/or expenses for all Hazardous Materials/Substances brought to the site. The Contractor shall not and is strictly prohibited from purchasing and/or installing any asbestos-containing materials or products as part of the Work. Should the Contractor do so, the Contractor shall be solely responsible for the immediate remediation and all costs, damages, loss, and/or expenses per Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.

10.2.3. If the Contractor encounters Hazardous Materials/Substances during the course of the Work, whether or not identified in the Contract Documents, Work, the Contractor agrees that:

10.2.3.1. Encountering any Hazardous Materials/Substances during performance of the Work does not necessarily mean a change in conditions has occurred, nor is it evidence that the Contractor is due additional Contract Time or an increase in the Contract Sum. If encountering Hazardous Materials/Substances is determined to be a change in conditions to the Contract Documents, Paragraph 4.3 and Article 7 apply in determining any additional compensation or extension of time claimed by the Contractor.

10.2.3.2. The Contractor is solely responsible for securing the Work in accordance with this Article 10 involving any Hazardous Materials/Substances against unlawful, unregulated, or improper intrusion, disturbance, or removal. The Contractor shall implement protections and take protective actions throughout the performance of the Work to prevent exposure to workers, occupants, and contamination of the site or area.

10.2.3.3. If the Contractor is unable to or fails to properly secure the Work against unlawful, unregulated, or improper intrusion, disturbance, or removal of Hazardous Materials/Substances, the Contractor shall immediately implement protections and take protective actions, up to and including stopping Work in the area or on the item affected, to prevent exposure to workers, occupants, and contamination of the site or area. The Contractor shall immediately notify the Owner and Architect in writing giving details of the failure and the corrective actions taken. If the condition is an emergency and notice cannot be provided in writing, then Contractor shall

orally and immediately notify the Owner and Architect/Engineer of the condition followed by a full written explanation. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss.

10.2.3.4. If the Contractor notifies the Owner and takes precautions in accordance with this Article 10 upon encountering materials/substances suspected of containing asbestos or polychlorinated biphenyls that are unidentified in the Contract Documents, the Owner shall verify if the unidentified material or substance contains asbestos or polychlorinated biphenyls and shall arrange for the removal or other measures as necessary to allow the Contractor to proceed with the Work. The Contract Time may be extended as appropriate if the Work affected is on the critical path and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs as provided in Article 7. Should the Contractor fail to notify the Owner upon encountering asbestos, polychlorinated biphenyls, or materials/substances suspected of containing asbestos or polychlorinated biphenyls, that are unidentified in the Contract Documents, the Contractor is solely responsible for all mitigation in accordance with Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.

10.2.4. The Contractor shall indemnify, hold harmless, and defend the Owner from and against all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses, including but not limited to court costs and reasonable attorneys' fees, arising from, in connection with, or incidental to the Contractor's handling, disposal, encountering, or release of Hazardous Materials/Substances.

10.3. **UTILITIES**

10.3.1. Underground Utilities: Buried utilities, including, but not limited to, electricity, gas, steam, air, water, telephone, sewer, irrigation, broadband coaxial computer cable, and fiber optic cables are very vulnerable and damage could result in loss of service. The telephone, broadband and fiber optic cables are especially sensitive and the slightest damage to these components will result in disruption of the operations of the campus.

10.3.2. "One Call" must be notified by phone and in writing at least 72 hours (3 business days) prior to digging to arrange and assist in the location of buried utilities in the field. (Dial 811). The Contractor shall mark the boundary of the work area. The boundary area shall be indicated with white paint and white flags. In winter, pink paint and flags will be accepted.

10.3.3. After buried utilities have been located, the Contractor shall be responsible for any utilities damaged while digging. Such responsibility shall include all necessary care including hand digging. Contractor's responsibility shall also include maintaining markings after initial locate. The area for such responsibility, unless otherwise indicated, shall extend 24 inches to either side of the marked center line of a buried utility line.

10.3.4. The Contractor's responsibility shall include repair or replacement of damaged utilities. The Contractor will also be responsible for all costs associated with reterminations and recertification.

10.3.5. Any buried utilities exposed by the operations of the Contractor shall be marked on the plans and adequately protected by the Contractor. If any buried utilities not located are exposed, the Contractor shall immediately contact the Owner and the Architect/Engineer. If, after exposing an unlocated buried utility, the Contractor continues digging without notifying Owner and Architect/Engineer and further damages the utility, the Contractor will be fully and solely responsible.

10.3.6. Damage to irrigation systems during seasons of no irrigation that are not immediately and adequately repaired and tested will require the Contractor to return when the system is in service to complete the repair.

10.3.7. In the event of a planned interruption of any existing utility service, the Contractor shall make arrangements with Owner at least 72 hours (3 business days) in advance. Shutdowns of the broadband or fiber optic cables will normally require 5 working days' notice to the Owner. The Contractor shall bear all costs associated with the interruptions and restorations of service.

ARTICLE 11 - INSURANCE AND BONDS

11.1. **CONTRACTOR'S LIABILITY INSURANCE**

11.1.1. The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the State of Montana with a rating no less than "A-", such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

11.1.1.1. claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;

11.1.1.2. claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

11.1.1.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

11.1.1.4. claims for damages insured by usual personal injury liability coverage;

11.1.1.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting there from;

11.1.1.6. claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

11.1.1.7. claims for bodily injury or property damage arising out of completed operations; and,

11.1.1.8. claims involving contractual liability insurance applicable to the Contractor's obligations under Paragraph 3.18.

11.1.2. The insurance required by Subparagraph 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until termination of any coverage required to be maintained after final payment.

11.1.3. Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies except Workers Compensation required by this Paragraph 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner. The Workers Compensation policy will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner by the Contractor. If any of the foregoing insurance coverages are required to remain in force after final payment, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Subparagraph 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

11.1.4. At the request of the Owner, the Contractor shall provide copies of all insurance policies to the Owner.

11.2. **INSURANCE, GENERAL REQUIREMENTS**

11.2.1. The Contractor shall maintain for the duration of the contract, at its cost and expense, insurance against claims for injuries to persons or damages to property, including contractual liability, which may arise from or in connection with the performance of the Work by the Contractor, its agents, employees, representatives, assigns, or subcontractors. The Contractor is responsible for all deductibles regardless

of policy or level of coverage. The Owner reserves the right to demand, and the Contractor agrees to provide, copies of any and all policies at any time.

11.2.2. Hold Harmless and Indemnification: The Contractor shall protect, defend, and save the state, its elected and appointed officials, agents, and employees, while acting within the scope of their duties as such, harmless from and against all claims, liabilities, demands, causes of action, and judgments whatsoever (including the cost of defense and reasonable attorney fees): 1) arising in favor of or asserted by third parties on account of damage to property, personal injury, or death which injury, death, or damage; or, 2) arising out of or resulting from performance or failure to perform, or omissions of services, or in any way results from the negligent acts or omissions of the Contractor, its agents, agents, or subcontractors.

11.2.3. Contractor's Insurance: insurance required under all sections herein shall be in effect for the duration of the contract that extends through the warranty period. Insurance required herein shall be provided by insurance policies issued only by insurance companies currently authorized to do business in the state of Montana. No Contractor or Sub-contractor shall commence any Work under this contract until all required insurance has been obtained. During the term of this contract, the Contractor shall, not less than thirty days prior to the expiration date of any policy for which a certificate of insurance is required, deliver to the Owner a certificate of insurance with respect to the renewal insurance policy. The Contractor shall furnish one copy of insurance certificates of insurance herein required, which shall specifically set forth evidence of all coverage required by these contract documents and which shall be signed by authorized representatives of the insurance company or companies evidencing that insurance as required herein is in force with the exception of Workers Compensation and will not be canceled, limited or restricted without thirty days' written notice by certified mail to the contractor and the Owner. The Workers Compensation policy will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner by the Contractor. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. Additionally, all certificates shall include the project name and A/E project number.

11.2.4. Certificates of Insurance and Endorsements. All certificates of insurance and the additional insured endorsements are to be received by the state prior to issuance of the Contract for Construction. The contractor is responsible to ensure that all policies and coverages contain the necessary endorsements for the State being listed as an additional insured. The state reserves the right to require complete copies of all insurance policies at any time to verify coverage. The contractor shall notify the state within 30 days of any material change in coverage.

11.3. **WORKERS' COMPENSATION INSURANCE**

11.3.1. The Contractor shall carry **Workers' Compensation Insurance**. Such Workers' Compensation Insurance shall protect the Contractor from claims made by his own employees, the employees of any Sub-contractor, and also claims made by anyone directly or indirectly employed by the Contractor or Sub-contractor. The Contractor shall require each Sub-contractor similarly to provide Workers' Compensation Insurance.

11.4. **COMMERCIAL GENERAL LIABILITY INSURANCE**

11.4.1. Each Contractor shall carry per occurrence coverage **Commercial General Liability Insurance** including coverage for premises; operations; independent contractor's protective; products and completed operations; products and materials stored off-site; broad form property damage and comprehensive automobile liability insurance with not less than the following limits of liability:

11.4.1.1. **$1,000,000 per occurrence; aggregate limit of $2,000,000**;

11.4.2. The **Commercial General and Automobile Liability Insurance** shall provide coverage for both bodily injury, including accidental death, sickness, disease, occupational sickness or disease, personal injury liability coverage and property damage which may arise out of the work under this contract, or operations incidental thereto, whether such work and operations be by the Contractor or by any Subcontractor or by anyone directly or indirectly employed by the Contractor or by Sub-contractor, or by anyone for whose acts any of them may be liable. The Contractor shall maintain the liability insurance required herein for

a period of not less than one year after final payment or anytime the Contractor goes on to the location of the project.

11.4.3. The Contractor's liability insurance policies shall list the STATE OF MONTANA as an additional insured. **AN ADDITIONAL INSURED ENDORSEMENT DOCUMENT SHALL BE SUBMITTED WITH THE CERTIFICATES OF INSURANCE**. The STATE OF MONTANA includes its officers, elected and appointed officials, employees and volunteers and political subdivisions thereof. Should the Contractor not be able to list the state as an additional insured, the Contractor shall purchase a per occurrence Owner's/Contractor's Protective Policy (OCP) with the STATE OF MONTANA as the insured party in the same occurrence and aggregate limits as that indicated above for the Contractor's Commercial General Liability Policy.

11.4.4. Property damage liability insurance shall be written without any exclusion for injury to or destruction of any building, structure, wires, conduits, pipes, or other property above or below the surface of the ground arising out of the blasting, explosion, pile driving, excavation, filling, grading or from the moving, shoring, underpinning, raising, or demolition of any building or structure or structural support thereof.

11.4.5. The Contractor's insurance coverage shall be PRIMARY insurance as respects the State, its officers, elected and appointed officials, employees and volunteers. Any insurance or self-insurance maintained by the state, its officers, elected and appointed officials, employees and volunteers shall be excess of the Contractor's insurance and shall not contribute to it. NO WAIVERS OF SUBROGATION OR ENDORSEMENTS LIMITING, TRANSFERRING, OR OTHERWISE INDEMNIFYING LIABLE OR RESPONSIBLE PARTIES OF THE CONTRACTOR OR ANY SUBCONTRACTOR WILL BE ACCEPTED.

11.5. **PROPERTY INSURANCE (ALL RISK)**

11.5.1. New Construction (for projects involving new construction): At its sole cost and expense, the contractor shall keep the building and all other improvements on the premises insured throughout the term of the agreement against the following hazards:

11.5.1.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map, NEHRP.pdf (mt.gov).pdf in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire insurance policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.

11.5.1.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.

11.5.1.3. Loss or damage by explosion of steam boilers, pressure vessels, and oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.

11.5.2. Building Renovation (for projects involving building renovation or remodeling):

11.5.2.1. The contractor shall purchase and maintain Builder's Risk/Installation insurance on a "special causes of loss" form (so called "all risk") for the cost of the work and any subsequent modifications and change orders. The contractor is not responsible for insuring the existing structure for Builder's Risk/Installation insurance.

11.5.2.2. At its sole cost and expense, the contractor shall insure all property construction on the premises throughout the term of the agreement against the following hazards:

11.5.2.2.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map at http://rmtd.mt.gov/Portal/62/aboutus/publications/files/NEHRP.pdf in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended

coverage endorsement to fire policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.

11.5.2.2.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.

11.5.2.2.3. Loss or damage by explosion of steam boilers, pressure vessels, oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.

11.6. **ASBESTOS ABATEMENT INSURANCE**

11.6.1. If Asbestos Abatement is identified as part of the Work under this contract, the Contractor or any subcontractor involved in asbestos abatement shall purchase and maintain **Asbestos Liability Insurance** for coverage of bodily injury, sickness, disease, death, damages, claims, errors or omissions regarding the asbestos portion of the work ***in addition to*** the CGL Insurance by reason of any negligence in part or in whole, error or omission committed or alleged to have been committed by the Contractor or anyone for whom the Contractor is legally liable.

11.6.2. Such insurance shall be in "per occurrence" form and shall clearly state on the certificate that asbestos work is included in the following limits:

11.6.2.1. **$1,000,000 per occurrence; aggregate limit of $2,000,000.**

11.6.3. Asbestos Liability Insurance as carried by the asbestos abatement subcontractor in these limits in lieu of the Contractor's coverage is acceptable provided the Contractor and the State of Montana are named as additional insureds and that the abatement subcontractor's insurance is PRIMARY as respects both the Owner and the Contractor. If the Contractor or any other subcontractor encounters asbestos, all operations shall be suspended until abatement with the associated air monitoring clearances are accomplished. The certificate of coverage shall be provided by the asbestos abatement subcontractor to both the Contractor and the Owner.

11.7. **PERFORMANCE BOND AND LABOR & MATERIAL PAYMENT BOND (BOTH ARE REQUIRED ON PROJECTS EXCEEDING $150,000.00 IN VALUE)**

11.7.1. The Contract shall furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201 MCA). The Contractor shall also furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201MCA). The bonds shall be executed on forms furnished by the Owner and no other forms or endorsements will be acceptable. The bonds shall be signed in compliance with state statutes (33-17-1111 MCA). Bonds shall be secured from a state licensed bonding company. Power of Attorney is required with each bond. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney:

11.7.1.1. one original copy shall be furnished with each set of bonds.

11.7.1.2. Others furnished with a set of bonds may be copies of that original.

11.7.2. The Owner reserves the right at any time during the performance of Work to require bonding of Subcontractors provided by the General Contractor. Should this occur, the Owner will cover the direct cost. This shall not be construed as to in any way affect the relationship between the General Contractor and his Subcontractors.

11.7.3. Surety must have an endorsement stating that their guarantee of Contractor's performance automatically covers the additional contract time added to a Contractor's contract by Change Order.

11.7.4. A change in the Contractor's organization shall not constitute grounds for Surety to claim a discharge of their liability and requires an endorsement from Surety so stating.

11.7.5. Except as noted below, the Contractor is required to notify Surety of any increase in the contract amount resulting from a Change Order within 48 hours of signing and submitting a Change Order and shall submit a copy of Surety's written acknowledgment and consent to Owner before a Change Order can be approved. The Surety's written acknowledgment and consent on the Change Order form shall also satisfy this consent requirement.

11.7.5.1. Surety consent shall not be required on Change Order(s) which, in the aggregate total amount of all Changes Orders, increase the original contract amount by less than 10%. However, the Contractor is still required to notify Surety of any increase in contract amount resulting from a Change Order(s) within 48 hours of signing and submitting every Change Order.

11.7.5.2. Surety is fully obligated to the Owner for the full contract amount, inclusive of all Change Orders, regardless of whether or not written acknowledgement and consent is received and regardless of whether or not the aggregate total of all Change Orders is more or less than 10% of the original contract amount.

11.7.5.3. A fax with hard copy to follow of Surety's written acknowledgment and consent is acceptable. If hard copy is not received by Owner before Application for Payment on any portion or all of said Change Order, it will not be accepted by Owner for payment.

11.7.6. The Surety must take action within 30 days of notice of default on the part of the Contractor or of any claim on bonds made by the Owner or any Subcontractor or supplier.

ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

12.1. UNCOVERING OF WORK

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

12.1.2. If a portion of the Work has been covered which the Architect/Engineer has not specifically requested to examine prior to it being covered, the Architect/Engineer may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

12.2. CORRECTION OF WORK

12.2.1. BEFORE OR AFTER SUBSTANTIAL COMPLETION

12.2.1.1. The Contractor shall promptly correct Work that fails to conform to the requirements of the Contract Documents or that is rejected by the Architect/Engineer, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect/Engineer's services and expenses made necessary thereby, shall be at the Contractor's expense. The Contractor is responsible to discover and correct all defective work and shall not rely upon the Architect/Engineer's or Owner's observations.

12.2.1.2. Rejection and Correction of Work in Progress. During the course of the Work, the Contractor shall inspect and promptly reject any Work that:

12.2.1.2.1. does not conform to the Construction Documents; or,
12.2.1.2.2. does not comply with any applicable law, statute, building code, rule or regulation of any governmental, public and quasi-public authorities, and agencies having jurisdiction over the Project.

12.2.1.3. The Contractor shall promptly correct or require the correction of all rejected Work, whether observed before or after Substantial Completion. The Contractor shall bear all costs of correcting such Work, including additional testing, inspections, and compensation for all services and expenses necessitated by such corrective action.

12.2.2. **AFTER SUBSTANTIAL COMPLETION AND AFTER FINAL ACCEPTANCE**

12.2.2.1. In addition to the Contractor's obligations under Paragraph 3.5, if, within one year after the date of Final Acceptance of the Work or designated portion thereof or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect/Engineer, the Owner may correct it in accordance with Paragraph 2.3.

12.2.2.1.1. The Contractor shall remedy any and all deficiencies due to faulty materials or workmanship and pay for any damage to other work resulting there from, which shall appear within the period of Substantial Completion through one (1) year from the date of Final Acceptance in accordance with the terms and conditions of the Contract and with any special guarantees or warranties provided in the Contract Documents. The Owner shall give notice of observed deficiencies with reasonable promptness. All questions, claims or disputes arising under this Article shall be decided by the Architect/Engineer. All manufacturer, product and supplier warranties are in addition to this Contractor warranty.

12.2.2.1.2. The Contractor shall respond within seven (7) days after notice of observed deficiencies has been given and he shall proceed to immediately remedy these deficiencies.

12.2.2.1.3. Should the Contractor fail to respond to the notice or not remedy those deficiencies; the Owner shall have this work corrected at the expense of the Contractor.

12.2.2.1.4. Latent defects shall be in addition to those identified above and shall be the responsibility of the Contractor per the statute of limitations for a written contract (27-2-208 MCA) starting from the date of Final Acceptance.

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

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

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

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

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

which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

12.3. **ACCEPTANCE OF NONCONFORMING WORK**

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

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1. **GOVERNING LAW**

13.1.1. The Contract shall be governed by the laws of the State of Montana and venue for all legal proceedings shall be the First Judicial District, Lewis & Clark County.

13.2. **SUCCESSORS AND ASSIGNS**

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

13.3. **WRITTEN NOTICE**

13.3.1. Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

13.4. **RIGHTS AND REMEDIES**

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

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

13.5. **TESTS AND INSPECTIONS**

13.5.1. Quality Control (i.e. ensuring compliance with the Contract Documents) and Quality Assurance (i.e. confirming compliance with the Contract Documents) are the responsibility of the Contractor. Testing, observations, and/or inspections performed or provided by the Owner are solely for the Owner's own purposes and are for the benefit of the Owner. The Owner is not liable or responsible in any form or fashion to the Contractor regarding quality control or assurance or extent of such assurances. The Contractor shall not, under any circumstances, rely upon the Owner's testing or inspections as a substitute or in lieu of its own Quality Control or Assurance programs.

13.5.2. Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect/Engineer timely notice of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. The Owner shall bear

costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.

13.5.3. If the Architect/Engineer, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Subparagraph 13.5.2, the Architect/Engineer will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect/Engineer of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. Such costs, except as provided in Subparagraph 13.5.4 shall be at the Owner's expense.

13.5.4. If such procedures for testing, inspection or approval under Subparagraphs 13.5.2 and 13.5.3 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect/Engineer's services and expenses shall be at the Contractor's expense.

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

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

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

13.6. **INTEREST**

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

13.7. **COMMENCEMENT OF STATUTORY LIMITATION PERIOD**

13.7.1. As between the Owner and Contractor:

13.7.1.1. **Before Substantial Completion.** As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

13.7.1.2. **Between Substantial Completion and Final Certificate for Payment.** As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and,

13.7.1.3. **After Final Payment.** As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Paragraph 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

13.8. **PAYROLL AND BASIC RECORDS**

13.8.1. Payrolls and basic records pertaining to the project shall be kept on a generally recognized accounting basis and shall be available to the Owner, Legislative Auditor, the Legislative Fiscal Analyst or his

authorized representative at mutually convenient times. Accounting records shall be kept by the Contractor for a period of three years after the date of the Owner's Final Acceptance of the Project.

ARTICLE 14 – TERMINATION OR SUSPENSION OF THE CONTRACT

14.1. TERMINATION BY THE CONTRACTOR

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

14.1.1.1. issuance of an order of a court or other public authority having jurisdiction which requires all Work to be stopped; or,

14.1.1.2. an act of government, such as a declaration of national emergency which requires all Work to be stopped.

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

14.1.3. If one of the reasons described in Subparagraph 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect/Engineer, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit but not damages.

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

14.2. TERMINATION BY THE OWNER FOR CAUSE

14.2.1. The Owner may terminate the Contract if the Contractor:

14.2.1.1. persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

14.2.1.2. fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

14.2.1.3. persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or,

14.2.1.4. otherwise is guilty of any breach of a provision of the Contract Documents.

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

14.2.2.1. take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

14.2.2.2. accept assignment of subcontracts pursuant to Paragraph 5.4; and,

14.2.2.3. finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

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

14.2.4. If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect/Engineer's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect/Engineer, upon application, and this obligation for payment shall survive termination of the Contract.

14.3. **SUSPENSION BY THE OWNER FOR CONVENIENCE**

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

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

14.3.2.1. that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or,

14.3.2.2. that an equitable adjustment is made or denied under another provision of the Contract.

14.4. **TERMINATION BY THE OWNER FOR CONVENIENCE**

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

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

14.4.2.1. cease operations as directed by the Owner in the notice;

14.4.2.2. take actions necessary, or that the Owner may direct, for the protection and preservation of the Work, and;

14.4.2.3. except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

14.4.3. In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination. The Contractor shall provide a full and complete itemized accounting of all costs.

ARTICLE 15 – EQUAL OPPORTUNITY

15.1. The Contractor and all Sub-contractors shall not discriminate against any employee or applicant for employment because of race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability and shall comply with all Federal and State laws concerning fair labor standards and hiring practices. The Contractor shall ensure that applicants are employed, and that employees are treated during employment, without regard to race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social

origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability.

15.2. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

15.3. The Contractor and all Sub-contractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability.

15.4. The contractor shall not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association, and the Contractor shall not discriminate during the term of the contract against a firearm entity or firearm trade association. This section shall be construed in accordance with 30-20-301, MCA.

15.4.1. The provisions of 30-20-301, MCA apply only to a contract that:

15.4.1.1. is between a governmental entity and a company with at least 10 full-time employees; and

15.4.1.2. has a value of at least $100,000 that is paid wholly or partly from public funds of the governmental entity.

15.4.2. By the signing the contract, the Contractor certifies and affirms:

15.4.2.1. Contractor does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association during the term of this contract; and

15.4.2.2. Contractor will not discriminate against a firearm entity or firearm trade association during the term of this contract.

15.4.3. The contractor's certification is made in compliance with and in reference to 30-20-301, MCA, and the terms defined therein. If the contractor determines the provisions of 30-20-301, MCA don't apply to the contract, the Contractor shall submit a statement set forth in details the basis for such determination.

[END OF GENERAL CONDITIONS]

MONTANA STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT
Sixth Avenue and Grant Street • P.O. Box 172760 • Bozeman, Montana 59717-2760
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SUPPLEMENTAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

(REVISED FEBRUARY 2025)

FOR STATE OF MONTANA GENERAL CONDITIONS

ARTICLE 1 – GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.3 SPECIFICATIONS

1.1.3.1 ADD: "Approved": When used to convey Architect's/Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's/Engineer's duties and responsibilities as stated in the Conditions of the Contract.

1.1.3.2 ADD: "Directed": A command or instruction by Architect/Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

1.1.3.3 ADD: "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

1.1.3.4 ADD: "Regulations": Laws ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

1.1.3.5 ADD: "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

1.1.3.6 ADD: "Install": Operations at Project site including unloading, temporarily shoring, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

1.1.3.7 ADD: "Provide": Furnish and install, complete and ready for the intended use.

1.1.3.8 ADD: "Project site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land or portion of the building on which the Project is to be built.

1.6.1 Insert in the sixth line: "All documents which constitute the instruments of service are the property of the Owner." In lieu of the phrase "Unless otherwise indicated, the Architect/Engineer and the Architect/Engineer's consultants shall be deemed the authors of them… except as defined in the Owner's Contract with the Architect/Engineer."

ARTICLE 2 – THE OWNER

2.1 THE STATE OF MONTANA

2.1.1.1 ADD: The State of Montana includes its officers, elected and approved officials, employees and volunteers, and political subdivisions thereof. The State of Montana and Montana State University are synonymous throughout the contract documents.

ARTICLE 3 – THE CONTRACTOR

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.6 ADD: PRODUCT DELIVERY, STORAGE AND HANDLING

3.3.6.1 ADD: Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

3.3.6.2 ADD: DELIVERY AND HANDLING:

3.3.6.2.1 ADD: Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

3.3.6.2.2 ADD: Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3.3.6.2.3 ADD: Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

3.3.6.2.4 ADD: Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and property protected.

3.3.6.3 ADD: STORAGE

3.3.6.3.1 ADD: Store products to allow for inspection and measurement of quantity or counting of units

3.3.6.3.2 ADD: Store materials in a manner that will not endanger Project structure.

3.3.6.3.3 ADD: Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

3.3.6.3.4 ADD: Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

3.3.6.3.5 ADD: Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

3.3.6.3.6 ADD: Protect stored products from damage and liquids from freezing.

3.10 CONSTRUCTION SCHEDULES

3.10.1.1 ADD: A pre-construction meeting will be held at a time mutually agreed upon by the Owner, Architect/Engineer and Contractor at Campus Planning, Design and Construction, Montana State University, Bozeman, Montana. The contractor shall confirm the Contractor's Construction Schedule for the Work. Coordination of operating requirements of the affected buildings, and surrounds, schedule of activities and Owner requirements will be discussed, as well as the order in which the Contractor intends to pursue the work. This schedule will be reviewed and must be mutually agreed upon by the Architect, Contractor and Owner.

3.11 DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE

3.11.4 ADD: The contractor shall maintain at the site two (2) construction reference sets of all specifications, drawings, approved shop drawings, change orders and other modifications, addenda, schedules and instructions, in good order.

3.11.4.1 ADD: The record drawings shall be two (2) sets of black (or blue) and white prints of the drawings on which the contractor must record all "red line" changes during the course of construction and will include references to change order numbers, field directives, etc., and their dates. This record set shall be maintained separate and apart from documents used for construction reference. This set will be available for review by the project consultant, architect, engineer and MSU project manager at all times.

3.11.4.2 ADD: All as-built conditions shall be kept current and the contractor shall not permanently conceal or cover any work until all required information has been recorded.

3.11.4.3 ADD: All survey and exterior underground utilities shall be recorded using the spatial reference, Montana State Plane, NAD 83, CORS 96, Lambert Conformal Conic. The National Geodetic Survey publishes NAD 83

coordinates in the metric system (i.e., meters). The conversion factor that should be used to convert between English and metric systems is the international conversion factor of 1 ft. = 0.3048 m. coordinate system.

3.11.4.4 ADD: In marking any as-built conditions, the contractor shall ensure that such drawings indicate by measured dimension to building corners or other permanent monuments the exact locations of all piping, conduit or utilities concealed in concrete slabs, behind walls or ceilings or underground. Record drawings shall be made to scale and shall also include exact locations of valves, pull boxes and similar items as required for maintenance or repair service.

3.11.4.5 ADD: The contractor shall prepare and maintain a binder with all project warranty information. This will be provided to the project consultant, architect or engineer at final acceptance.

3.12.1 DEFINITIONS:

3.12.1.4 ADD: Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

3.12.1.5 ADD: Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.

3.12.1.6 ADD: New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3.12.1.7 ADD: Comparable Products: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

3.12.1.8 ADD: Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specifications.

3.13. <u>USE OF SITE</u>

3.13.3 ADD: MSU BOZEMAN Vehicle Regulations state:

"All students, faculty, staff, and visitors must register any motor vehicle they park on the University campus, for any reason. A visitor is anyone not defined as student, staff or faculty."

All Contractor and Contractor employees shall comply with Montana State University parking regulations. MSU parking permits can be purchased at 100 Swingle Building at S. Seventh Ave. and Grant St. Contractor should call University Police at 994-2121 for permit information. Violators of MSU Bozeman Vehicle Regulations may be ticketed and towed.

Unless otherwise indicated on the drawings, all Contractor and Contractor employee vehicles on campus shall be parked in designated parking lots. If allowed on the drawings, vehicles to a maximum number stated, may be parked in project site areas designated and shall only be Contractor vehicles with company signs clearly visible. No personal vehicles shall be parked at the project site in any case. If a driver of a vehicle not allowed to be parked at the project site must unload equipment, tools, or materials, the vehicle must be immediately thereafter moved to a designated lot or leave campus. Vehicles parked in the project site, other than those allowed on the drawings, may be ticketed and towed.

Access to the project site shall be only by the route designated on the drawings. In cases where a different route must be used for a specific purpose, permission must be obtained from MSU Facilities Services. In no case will vehicles be used on the Centennial Mall paving. Access routes are for delivery of equipment, tools, and not for parking.

Site staging areas for materials and equipment if permitted, will be designated on the drawings if permitted. If not designated, staging is intended to be in the construction area boundaries. Staged materials and equipment must be secured on the ground surface or in trailers. Site staging areas shall be fenced.

3.13.4 ADD: The Contractor shall coordinate his operations with the Owner in order that the Owner will have maximum use of existing facilities surrounding the area of the Work, as agreed upon, at all times during normal working hours. Contractor further agrees to coordinate his operations so as to avoid interference with the Owner's normal operations to as great an extent as possible.

3.13.5 ADD: By acceptance of MSU Building Keys the Contractor agrees with the following: University keys are the property of Montana State University. Fabricating, duplicating or modifying University keys is prohibited. Doors must remain locked at all times. The use of these keys to allow unauthorized persons to enter the above areas is prohibited. Loss of any key must be reported immediately to the Director, Office of Facilities Services and University Police, if the loss of keys results in re-keying costs, these costs will be charged to the Contractor. **See attached Estimated Re-Keying Costs.**

3.13.6 ADD: The Montana Legislature decreed that the "right to breath smoke-free air has priority over the desire to smoke" (MCA 20-40-102). It is the policy of MSU to promote the health, wellness and safety of all employees, students, guests, visitors, and contractors while on campus. Therefore, the campus will be free of tobacco-use effective August 1, 2012. The use of tobacco (including cigarettes, cigars, pipes, smokeless tobacco and all other tobacco products) by students, faculty, staff, guests, visitors, and contractors is prohibited on all properties owned or leased by MSU.

Littering any university property, whether owned or leased, with the remains of tobacco products is prohibited.

All university employees, students, visitors, guests, and contractors are required to comply with this policy, which shall remain in effect at all times. Refusal to comply with this policy may be cause for disciplinary action in accordance with employee and student conduct policies. Refusal to comply with the policy by visitors, guests and contractors may be grounds for removal from campus. (http://www2montana.edu/policy/smoking_facilities/)

3.13.7 ADD: The Contractor may use the University's toilet facilities only as directed by the Owner.

ARTICLE 4 – ADMINISTRATION OF THE CONSTRUCTION CONTRACT

4.6. ARBITRATION

4.6.3 Insert in the second line "the Eighteenth Judicial District, Gallatin County" in lieu of "First Judicial District, Lewis & Clark County."

4.6.11 ADD: In responding to a claim brought by a Contractor, the Owner shall have a minimum of forty-five (45) days in which to respond to a revised claim prior to the arbitration hearing.

ARTICLE 7 – CHANGES IN WORK

7.2 CHANGE ORDERS

7.2.2.1 Insert the word "maximum" before "5%" and insert the word "maximum" before "10%".

7.2.2.4 ADD: Total Change Order markup shall not exceed (cost of the work) x 1.15.

7.2.3.1 Insert at the beginning of the first sentence the word "Itemized".

7.2.3.2 Insert at the beginning of the first sentence the word "Itemized".

7.2.3.3 Insert at the beginning of the first sentence the word "Itemized".

7.2.3.4 ADD: The Contractor shall provide a complete description summarizing all work involved.

ARTICLE 8 - TIME

8.1. DEFINITIONS

8.1.8.1 ADD: Work commenced before receipt and signature by all parties of the Contract for Construction will be entirely at the Contractor's risk.

8.2. PROGRESS AND COMPLETION

8.2.5 ADD: Completion of the work within the stated time and/or by the date stated in the executed Contract for Construction is of the essence of this Contract and failure to complete, without approved time extension, may be considered default of the Contract. At the time for completion as stated in the executed Contract or as extended by approved change order, if the work is not substantially complete, the Owner may notify the Contractor and the Contractor's surety company in writing of the recourse the Owner intends to take, within the Contract, to assess liquidated damages and /or cause the work to be completed.

8.3. DELAYS AND EXTENSIONS OF TIME

8.3.4 ADD: By the act of signing the Contract, the Contractor signifies that he/she and all subcontractors can perform the work within the stated schedule and that subcontractors, manufacturers, suppliers, and deliverers are known to be able to support the schedule. Time extension may be granted for unforeseen conditions or events out of the Contractor's control causing delay in delivery of materials or causing delay in the Contractor's ability to perform the work within the Contract Documents. The Contractor is expected to take all possible measures and bear all reasonable costs in order to anticipate, control, counteract, and expedite such delay-causing conditions, including finding alternative sources of materials, equipment, shipping, and labor. Notification of any claim for schedule delay must be made in writing to the Owner within one week of the causing event or of first knowledge of a known delay causing condition with supporting documentation as required by the Owner. The Owner will respond in writing within one week to claims of delay. No claims of delay will be entertained after the date of completion as stated in the executed Contract or as extended by previously approved delay claims.

ARTICLE 9 – PAYMENTS AND COMPLETION

9.3. APPLICATIONS FOR PAYMENT

9.3.7.2.1. Insert in the first line "Schedule of Values" in lieu of "Schedule of Amounts for Contract Payment".

9.3.7.2.3 ADD: Subcontractor's List: The Contractor shall list all subcontractors doing work in excess of $5,000.

9.8. SUBSTANTIAL COMPLETION

9.8.4.1 ADD: Prior to the inspection, the Contractor shall complete the final clean-up of the project site which, unless otherwise stated in the Contract Documents, shall consist of:

9.8.4.1.1 Removal of all debris and waste. All construction debris and waste shall be removed from the campus grounds. Use of the University trash containers will not be permitted.

9.8.4.1.2 Removal of all stains, smears, marks of any kind from surfaces including existing surfaces if said damage is the result of the work.

9.8.4.1.3 Removal of all temporary structures and barricades.

9.10. FINAL COMPLETION AND FINAL PAYMENT

9.10.2.4 Insert in the first line after the word "(Form 103)": "for contracts greater than or equal to $150,000"

ARTICLE 10 – PROTECTIONS OF PERSONS AND PROPERTY

10.1. SAFETY

10.1.2 Insert in the second line before the word "safeguards": "and as approved by Owner,"

10.1.2.1 ADD: The Contractor recognizes that the Work will be conducted in and around buildings and areas that are occupied and will continue to function for the purposes of the University. The Contractor shall conduct a project safety meeting prior to the start of the Work, with the Owner's representative and all others that the Owner's representative deems necessary. The purpose of the meeting shall be to produce project specific rules and guidelines pertaining to but not restricted to: safety of persons in and around the area of the Work including type and location of fencing, guards, signage, etc.; closing of existing campus circulation routes and designation of alternate routes,

including creation of temporary routes of access as required; creation and location of temporary signage as required to maintain accessible routes for handicapped access to and around the site of the Work. The Contractor shall be solely responsible for implementing all required means and methods for site safety and security that may be agreed upon in this meeting.

10.1.2.2 ADD: Contractor shall notify Owner any time his operations will disrupt use of and access to existing accessible routes. Contractor is solely responsible for maintaining existing accessible routes in the area of the project with the exception of temporary interruptions lasting one day or less. Contractor is responsible for erecting signage identifying temporary re-routing of accessible routes. Such re-routing shall be coordinated with Owner in advance.

10.3. UTILITIES

10.3.1 ADD: Underground Utilities: Buried utilities, including, but not limited to, electricity, gas, steam, air, water, telephone, sewer, irrigation, broadband coaxial computer cable, and fiber optic cables are very vulnerable and damage could result in loss of service. The telephone, broadband and fiber optic cables are especially sensitive and the slightest damage to these components will result in disruption of the operations of the campus.

10.3.2 ADD: "One Call" must be notified by phone and in writing at least 72 hours (3 business days) prior to digging to arrange and assist in the location of buried utilities in the field. (Dial 811). The Contractor shall mark the boundary of the work area. The boundary area shall be indicated with white paint and white flags. In winter, pink paint and flags will be accepted.

10.3.3 ADD: After buried utilities have been located, the Contractor shall be responsible for any utilities damaged while digging. Such responsibility shall include all necessary care including hand digging. Contractor's responsibility shall also include maintaining markings after initial locate. The area for such responsibility, unless otherwise indicated, shall extend 24 inches to either side of the marked center line of a buried utility line. In cases of multiple or overlapping utilities or inconclusive electronic locating signals, MSU Project Manager may specifically indicate a wider area for Contractor's responsibility.

10.3.4 ADD: The Contractor's responsibility shall include repair or replacement of damaged utilities. In the event of damage to the 15 KV electrical distribution system, the broadband or fiber optic cables, repair will consist of replacement from termination to termination. Facilities Services and the MSU Information Technology Center will verify repair and recertification. The Contractor will also be responsible for all costs associated with re-terminations and recertification.

10.3.5 ADD: Any buried utilities exposed by the operations of the Contractor shall be marked on the plans and adequately protected by the Contractor. If any buried utilities not located are exposed, the Contractor shall immediately contact Facilities Services at the numbers above. If, after exposing an unlocated buried utility, the Contractor continues digging without notifying Facilities Services and further damages the utility, the Contractor will be responsible.

10.3.6 ADD: Damage to irrigation systems during seasons of no irrigation that are not immediately and adequately repaired and tested will require the Contractor to return when the system is in service to complete the repair.

10.3.7 ADD: In the event of a planned interruption of any existing utility service, the Contractor shall make arrangements with Facilities Services at least 72 hours (3 business days) in advance. Shutdowns of the broadband or fiber optic cables will normally require 5 working days notice to Facilities Services and the Information Technology Center. The Contractor shall bear all costs associated with the interruptions and restorations of service.

10.3.8 ADD: The Owner allows the contractor to use the Owner's utilities (water, heat, electricity) services without charge for procedures necessary for the completion of the work.

ARTICLE 11 - INSURANCE AND BONDS

11.4. COMMERCIAL GENERAL LIABILITY INSURANCE

11.4.1.3. Insert in the first line after "State of Montana": ", Montana State University".

11.7. PERFORMANCE BOND AND LABOR & MATERIAL PAYMENT BOND (BOTH ARE REQUIRED ON THIS PROJECT)

11.7.1. Insert in the first line at the beginning of the sentence "For contracts equal to or greater than $150,000".

11.8. CANCELLATION

11.8 ADD All Certificates shall contain a provision that coverage provided by the policies will not be cancelled without at least thirty (30) days prior notice to the Owner.

ARTICLE 13 – MISCELLANEOUS PROVISIONS

13.1. GOVERNING LAW

13.1.1. Insert in the second line "The Eighteenth Judicial District, Gallatin County" in lieu of "First Judicial District, Lewis and Clark County".

13.9 EMERGENCY AND PUBLIC SAFETY

Montana State University has an Emergency and Public Safety Alert System that warns the campus community in the event of an emergency or public safety event. Because contractors, consultants, and vendors are considered members of the campus community when working on campus, they must be familiar with the alert system and understand when the system is used. Montana State University requires all contractors, consultants, vendors, and their employees working on or entering the MSU-Bozeman campus to register for the Emergency and Public Safety Alert System. The link to register is: http://www.montana.edu/msualert/.

END OF SUPPLEMENTARY GENERAL CONDITIONS

MONTANA
STATE UNIVERSITY

FACILITIES SERVICES
PO BOX 172760, BOZEMAN, MONTANA 59717-2760
406/994-5413 FAX 406/994-5665

Cost Estimate to Re-key Buildings

Access to campus buildings is controlled for safety and security reasons. As a key holder the contractor is responsible for following processes associated with maintaining the integrity of our access control program. If a key is lost the contractor is liable for costs associated with ensuring access control is maintained. In some cases that requires re-keying an entire building or key sequence. Cost can range from $2,000 to over $200,000 depending on building and key hierarchy.

2026

MONTANA PREVAILING WAGE RATES FOR BUILDING CONSTRUCTION SERVICES***

***Downloaded on April 28, 2026 from DOLI website: https://erd.dli.mt.gov/labor-standards/state-prevailing-wage-rates/

MONTANA
PREVAILING WAGE RATES FOR BUILDING CONSTRUCTION SERVICES 2026

Effective: April 25, 2026

Greg Gianforte, Governor
State of Montana

Sarah Swanson, Commissioner
Department of Labor & Industry

To obtain copies of prevailing wage rate schedules, or for information relating to public works projects and payment of prevailing wage rates, visit ESD at erd.dli.mt.gov/labor-standards or contact:

Employment Standards Division
Montana Department of Labor and Industry
P. O. Box 8011
Helena, MT 59604
Phone 406-444-6543

The department welcomes questions, comments, and suggestions from the public. In addition, we'll do our best to provide information in an accessible format, upon request, in compliance with the Americans with Disabilities Act.

MONTANA PREVAILING WAGE REQUIREMENTS

The Commissioner of the Department of Labor and Industry, in accordance with Sections 18-2-401 and 18-2-402 of the Montana Code Annotated (MCA), has determined the standard prevailing rate of wages for the occupations listed in this publication.

The wages specified herein control the prevailing rate of wages for the purposes of Section 18-2-401, et seq., MCA. Each employer is required to pay (as a minimum) the rate of wages, including fringe benefits, travel allowance, zone pay and per diem applicable to the district in which the work is being performed as provided in the attached wage determinations.

All Montana Prevailing Wage Rates are available on the department's website at https://erd.dli.mt.gov/labor-standards/state-prevailing-wage-rates or by contacting the department at (406) 444-6543.

In addition, this publication provides general information concerning compliance with Montana's Prevailing Wage Law and the payment of prevailing wages. For detailed compliance information relating to public works contracts and payment of prevailing wage rates, please consult the regulations on the department's website at https://erd.dli.mt.gov/labor-standards/public-contracts-prevailing-wage-law/ or contact the department at (406) 444-6543.

SARAH SWANSON
Commissioner
Department of Labor and Industry
State of Montana

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A. Date of Publication

B. Definition of Building Construction

For the purposes of Prevailing Wage, the Commissioner of Labor and Industry has determined that building construction occupations are defined to be those performed by a person engaged in a recognized trade or craft, or any skilled, semi-skilled, or unskilled manual labor related to the construction, alteration, or repair of a public building or facility, and does not include engineering, superintendence, management, office or clerical work.

The Administrative Rules of Montana (ARM), 24.17.501(2) – 2(c), states *"Building construction projects generally are the constructions of sheltered enclosures with walk-in access for housing persons, machinery, equipment, or supplies. It includes all construction of such structures, incidental installation of utilities and equipment, both above and below grade level, as well as incidental grading, utilities and paving.*

Examples of building construction include, but are not limited to, alterations and additions to buildings, apartment buildings (5 stories and above), arenas (closed), auditoriums, automobile parking garages, banks and financial buildings, barracks, churches, city halls, civic centers, commercial buildings, court houses, detention facilities, dormitories, farm buildings, fire stations, hospitals, hotels, industrial buildings, institutional buildings, libraries, mausoleums, motels, museums, nursing and convalescent facilities, office buildings, out-patient clinics, passenger and freight terminal buildings, police stations, post offices, power plants, prefabricated buildings, remodeling buildings, renovating buildings, repairing buildings, restaurants, schools, service stations, shopping centers, stores, subway stations, theaters, warehouses, water and sewage treatment plants (buildings only), etc."

C. Definition of Public Works Contract

Section 18-2-401(11)(a), MCA defines "public works contract" as *"...a contract for construction services let by the state, county, municipality, school district, or political subdivision or for nonconstruction services let by the state, county, municipality, or political subdivision in which the total cost of the contract is in excess of $25,000..."*.

D. Prevailing Wage Schedule

This publication covers only Building Construction occupations and rates. These rates will remain in effect until superseded by a more current publication. Current prevailing wage rate schedules for Heavy Construction, Highway Construction, and Nonconstruction Services occupations can be found on the department's website at https://erd.dli.mt.gov/labor-standards/state-prevailing-wage-rates/ or by contacting the department at (406) 444-6543.

E. Rates to Use for Projects

ARM, 24.17.127(1)(c), states *"The wage rates applicable to a particular public works project are those in effect at the time the bid specifications are advertised."*

F. Wage Rate Adjustments for Multiyear Contracts

Section 18-2-417, MCA states:

"(1) Any public works contract that by the terms of the original contract calls for more than 30 months to fully perform must include a provision to adjust, as provided in subsection (2), the standard prevailing rate of wages to be paid to the workers performing the contract.

(2) The standard prevailing rate of wages paid to workers under a contract subject to this section must be adjusted 12 months after the date of the award of the public works contract. The amount of the adjustment must be a 3% increase. The adjustment must be made and applied every 12 months for the term of the contract.

(3) Any increase in the standard rate of prevailing wages for workers under this section is the sole responsibility of the contractor and any subcontractors and not the contracting agency."

G. Fringe Benefits

Section 18-2-412, MCA states:

"(1) To fulfill the obligation…a contractor or subcontractor may:

(a) pay the amount of fringe benefits and the basic hourly rate of pay that is part of the standard prevailing rate of wages directly to the worker or employee in cash;

(b) make an irrevocable contribution to a trustee or a third person pursuant to a fringe benefit fund, plan, or program that meets the requirements of the Employee Retirement Income Security Act of 1974 or that is a bona fide program approved by the U. S. department of labor; or

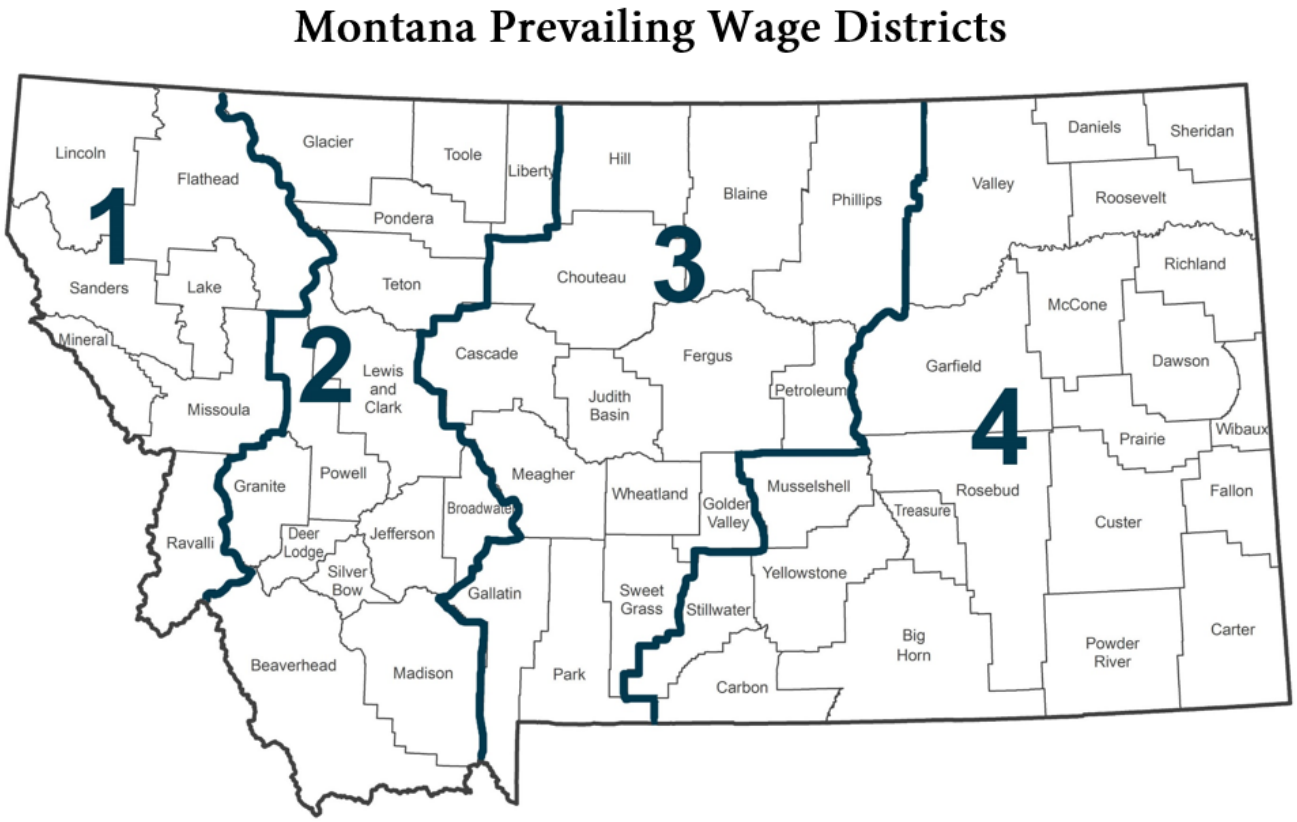
(c) make payments using any combination of methods set forth in subsections (1)(a) and (1)(b) so that the aggregate of payments and contributions is not less than the standard prevailing rate of wages, including fringe benefits and travel allowances, applicable to the district for the particular type of work being performed.

(2) The fringe benefit fund, plan, or program described in subsection (1)(b) must provide benefits to workers or employees for health care, pensions on retirement or death, life insurance, disability and sickness insurance, or bona fide programs that meet the requirements of the Employee Retirement Income Security Act of 1974 or that are approved by the U. S. department of labor."

Fringe benefits are paid for all hours worked (straight time and overtime hours). However, fringe benefits are not to be considered a part of the hourly rate of pay for calculating overtime, unless there is a collectively bargained agreement in effect that specifies otherwise.

H. Prevailing Wage Districts

Montana counties are aggregated into four districts for the purpose of prevailing wage. The prevailing wage districts are composed of the following counties, per ARM 24.17.107:



I. Dispatch City

Section 18-2-411(6), MCA, defines dispatch city as *"...the courthouse in the city from the following list which is closest to the center of the job: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, Miles City, Missoula and Sidney."* A dispatch city shall be considered the point of origin only for jobs within the counties identified in that district (as shown below):

District 1 – Kalispell and Missoula: includes Flathead, Lake, Lincoln, Mineral, Missoula, Ravalli, and Sanders;
District 2 – Butte and Helena: includes Beaverhead, Broadwater, Deer Lodge, Glacier, Granite, Jefferson, Lewis and Clark, Liberty, Madison, Pondera, Powell, Silver Bow, Teton, and Toole;
District 3 – Bozeman and Great Falls: includes Blaine, Cascade, Chouteau, Fergus, Gallatin, Golden Valley, Hill, Judith Basin, Meagher, Park, Petroleum, Phillips, Sweet Grass, and Wheatland;
District 4 – Billings, Miles City and Sidney: includes Big Horn, Carbon, Carter, Custer, Daniels, Dawson, Fallon, Garfield, McCone, Musselshell, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Stillwater, Treasure, Valley, Wibaux, and Yellowstone.

J. Zone Pay

Zone pay is not travel pay. ARM, 24.17.103(25), defines zone pay as *"...an amount added to the base pay; the combined sum then becomes the new base wage rate to be paid for all hours worked on the project. Zone pay must be determined by measuring the road miles one way over the shortest practical maintained route from the dispatch city to the center of the job."* See section I above for a list of dispatch cities.

K. Computing Travel Benefits

ARM, 24.17.103(23), states *"'Travel pay,' also referred to as 'travel allowance,' is and must be paid for travel both to and from the job site, except those with special provisions listed under the classification. The rate is determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city or the employee's home, whichever is closer, to the center of the job."* See section I above for a list of dispatch cities.

L. Per Diem

ARM, 24.17.103(19), states *"'Per diem' typically covers costs associated with board and lodging expenses. Per diem is paid when an employee is required to work at a location outside the daily commuting distance and is required to stay at that location overnight or longer."*

M. Apprentices

Wage rates for apprentices registered in approved federal or state apprenticeship programs are contained in those programs. Additionally, Section 18-2-416(2), MCA states *"...The full amount of any applicable fringe benefits must be paid to the apprentice while the apprentice is working on the public works contract."* Apprentices not registered in approved federal or state apprenticeship programs will be paid the appropriate journey level prevailing wage rate when working on a public works contract.

N. Posting Notice of Prevailing Wages

Section 18-2-406, MCA provides that contractors, subcontractors and employers who are *"...performing work or providing construction services under public works contracts, as provided in this part, shall post in a prominent and accessible site on the project or staging area, not later than the first day of work and continuing for the entire duration of the project, a legible statement of all wages and fringe benefits to be paid to the employees."*

O. Employment Preference

Sections 18-2-403 and 18-2-409, MCA requires contractors to give preference to the employment of bona fide Montana residents in the performance of work on public works contracts.

P. Projects of a Mixed Nature

Section 18-2-418, MCA states:

"(1) The contracting agency shall determine, based on the preponderance of labor hours to be worked, whether the public works construction services project is classified as a highway construction project, a heavy construction project, or a building construction project.

(2) Once the project has been classified, employees in each trade classification who are working on that project must be paid at the rate for that project classification"

Q. Occupations Definitions

You can find definitions for these occupations on the following Bureau of Labor Statistics website:
http://www.bls.gov/oes/current/oes_stru.htm

R. Welder Rates

Welders receive the rate prescribed for the craft performing an operation to which welding is incidental.

S. Foreman Rates

Rates are no longer set for foremen. However, if a foreman performs journey level work, the foreman must be paid at least the journey level rate.

WAGE RATES

BOILERMAKERS

No Rate Established

Duties Include:
Construct, assemble, maintain, and repair stationary steam boilers, boiler house auxiliaries, process vessels, and pressure vessels.

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BRICK, BLOCK, AND STONE MASONS

	Wage	Benefit
District 1	$33.81	$18.06
District 2	$33.81	$18.06
District 3	$33.81	$18.06
District 4	$33.81	$18.06

Per Diem:
0-70 mi. free zone
>70-90 mi. $60/day
>90 mi. $80/day

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CARPENTERS

	Wage	Benefit
District 1	$32.05	$16.33
District 2	$32.05	$16.33
District 3	$32.05	$16.33
District 4	$32.05	$16.33

Zone Pay:
0-30 mi. free zone
>30-60 mi. + $4.00/hr.
>60mi. + $6.00/hr.

Duties Include:
Construct, erect, install, or repair structures and fixtures made of wood and comparable materials, such as concrete forms; mass timber framing, building frameworks, including partitions, joists, studding, and rafters; and wood stairways, window and door frames, and hardwood floors. May also install cabinets, siding, drywall, and batt or roll insulation. Includes brattice builders who build doors or brattices (ventilation walls or partitions) in underground passageways.

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CARPET INSTALLERS

No Rate Established

Duties Include:
Lay and install carpet from rolls or blocks on floors. Install padding and trim flooring materials.

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CEMENT MASONS AND CONCRETE FINISHERS

	Wage	Benefit
District 1	$31.59	$5.29
District 2	$29.16	$3.13
District 3	$27.13	$0.96
District 4	$27.13	$0.96

Duties Include:
Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs. Align forms for sidewalks, curbs, or gutters.

Zone Pay:
0-30 mi. free zone
>30-60 mi. + $2.95/hr.
>60mi. + $4.75/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 1

	Wage	Benefit
District 1	$31.33	$15.05
District 2	$32.34	$16.79
District 3	$32.34	$16.79
District 4	$30.50	$16.79

This group includes but is not limited to:
Air Compressor; Auto Fine Grader; Belt Finishing; Boring Machine (Small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front-End Loader, under 1 cu. yd; Oiler, Herman Nelson Heater; Mucking Machine; Oiler, All Except Cranes/Shovels; Pumpman.

Zone Pay:
Districts 2 & 3
0-30 mi. base pay
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.
District 4
0-30 mi. free zone
>30-60 mi. + $3.05/hr.
>60 mi. + $4.85/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 2

	Wage	Benefit
District 1	$29.96	$11.13
District 2	$33.23	$16.79
District 3	$34.45	$16.79
District 4	$33.55	$19.55

This group includes but is not limited to:
Air Doctor; Backhoe\Excavator\Shovel, up to and incl. 3 cu. yds; Bit Grinder; Bituminous Paving Travel Plant; Boring Machine, Large; Broom, Self-Propelled; Concrete Travel Batcher; Concrete Float & Spreader; Concrete Bucket Dispatcher; Concrete Finish Machine; Concrete Conveyor; Distributor; Dozer, Rubber-Tired, Push, & Side Boom; Elevating Grader\Gradall; Field Equipment Serviceman; Front-End Loader, 1 cu. yd up to and incl. 5 cu. yds; Grade Setter; Heavy Duty Drills, All Types; Hoist\Tugger, All; Hydralift Forklifts & Similar; Industrial Locomotive; Motor Patrol (except finish); Mountain Skidder; Oiler, Cranes\Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumpcrete\Grout Machine; Punch Truck; Roller, other than Asphalt; Roller, Sheepsfoot (Self-Propelled); Roller, 25 tons and over; Ross Carrier; Rotomill, under 6 ft; Trenching Machine; Washing /Screening Plant.

Zone Pay:
District 2
0-30 mi. base pay
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.

District 3 & 4
0-30 mi. free zone
>30-60 mi. + $3.05/hr.
>60 mi. + $4.85/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 3

	Wage	Benefit
District 1	$31.02	$10.47
District 2	$34.65	$16.79
District 3	$33.29	$7.89
District 4	$34.65	$16.79

This group includes but is not limited to:
Asphalt Paving Machine; Asphalt Screed; Backhoe\Excavator\Shovel, over 3 cu. yds; Cableway Highline; Concrete Batch Plant; Concrete Curing Machine; Concrete Pump; Cranes, Creter; Cranes, Electric Overhead; Cranes, 24 tons and under; Curb Machine\Slip Form Paver; Finish Dozer; Front-End Loader, over 5 cu. yds; Mechanic\Welder; Pioneer Dozer; Roller Asphalt (Breakdown & Finish); Rotomill, over 6 ft; Scraper, Single, Twin, or Pulling Belly-Dump; YO-YO Cat Haul Truck, Articulating Trucks, Vac Truck.

Zone Pay:
Districts 2, 3 & 4
0-30 mi. base pay
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 4

	Wage	Benefit
District 1	$35.78	$16.79
District 2	$35.59	$15.56
District 3	$35.81	$15.78
District 4	$35.78	$16.79

This group includes but is not limited to:
Asphalt\Hot Plant Operator; Cranes, 25 tons up to and incl. 44 tons; Crusher Operator; Finish Motor Patrol; Finish Scraper.

Zone Pay:
All Districts
0-30 mi. free
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 5

	Wage	Benefit
District 1	$36.93	$16.79
District 2	$35.95	$15.49
District 3	$36.93	$16.79
District 4	$36.93	$16.79

This group includes but is not limited to:
Cranes, 45 tons up to and incl. 74 tons.

Zone Pay:
All Districts
0-30 mi. free
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 6

	Wage	Benefit
District 1	$38.06	$16.79
District 2	$38.06	$16.79
District 3	$38.06	$16.79
District 4	$38.06	$16.79

This group includes but is not limited to:
Cranes, 75 tons up to and incl. 149 tons; Cranes, Whirley (All).

Zone Pay:
All Districts
0-30 mi. free
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 7

	Wage	Benefit
District 1	$39.21	$16.79
District 2	$39.21	$16.79
District 3	$39.21	$16.79
District 4	$39.21	$16.79

This group includes but is not limited to:
Cranes, 150 tons up to and incl. 250 tons; Cranes, over 250 tons—add $1.00 per hr. for every 100 tons over 250 tons; Crane, Tower (All); Crane Stiff-Leg or Derrick; Helicopter Hoist.

Zone Pay:
All Districts
0-30 mi. free
>30-60 mi. + $3.50/hr.
>60 mi. + $5.50/hr.

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CONSTRUCTION LABORERS GROUP 1/FLAG PERSON FOR TRAFFIC CONTROL

No Rate Established

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CONSTRUCTION LABORERS GROUP 2

	Wage	Benefit
District 1	$28.42	$10.34
District 2	$27.42	$15.02
District 3	$27.90	$9.55
District 4	$26.80	$9.85

This group includes but is not limited to:
General Labor; Asbestos Removal; Burning Bar; Bucket Man; Carpenter Tender; Caisson Worker; Cement Mason Tender; Cement Handler (dry); Chuck Tender; Choker Setter; Concrete Worker; Curb Machine-lay Down; Crusher and Batch Worker; Heater Tender; Fence Erector; Landscape Laborer; Landscaper; Lawn Sprinkler Installer; Pipe Wrapper; Pot Tender; Powderman Tender; Rail and Truck Loaders and Unloaders; Riprapper; Sign Erection; Guardrail and Jersey Rail; Spike Driver; Stake Jumper; Signalman; Tail Hoseman; Tool Checker and Houseman.

Zone Pay:
All Districts
0-15 mi. free zone
>15-30 mi. + $0.65/hr
>30-50 mi. + $0.85/hr.
>50 mi. + $1.25/hr.

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CONSTRUCTION LABORERS GROUP 3

	Wage	Benefit
District 1	$26.56	NRE
District 2	$26.56	NRE
District 3	$26.02	NRE
District 4	$25.95	NRE

This group includes but is not limited to:
Concrete Vibrator; Dumpman (Grademan); Equipment Handler; Geotextile and Liners; High-Pressure Nozzleman; Jackhammer (Pavement Breaker) Non-Riding Rollers; Pipelayer; Posthole Digger (Power); Power Driven Wheelbarrow; Rigger; Sandblaster; Sod Cutter-Power and Tamper.

Zone Pay:
All Districts
0-15 mi. free zone
>15-30 mi. + $0.65/hr
>30-50 mi. + $0.85/hr.
>50 mi. + $1.25/hr.

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CONSTRUCTION LABORERS GROUP 4

	Wage	Benefit
District 1	$27.50	$12.22
District 2	$27.60	$12.22
District 3	$27.68	$9.45
District 4	$31.60	$12.22

This group includes but is not limited to:
Hod Carrier; Water Well Laborer; Blaster; Wagon Driller; Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete) Powderman; Rock & Core Drill; Track or Truck Mounted Wagon Drill and Welder incl. Air Arc.

Zone Pay:
All Districts
0-15 mi. free zone
>15-30 mi. + $0.65/hr
>30-50 mi. + $0.85/hr.
>50 mi. + $1.25/hr.

Per Diem:
0-70 mi. free zone
71-90 mi. $35/day
91+ mi. $80/day

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DRYWALL APPLICATORS

	Wage	Benefit
District 1	$32.05	$15.02
District 2	$32.05	$15.02
District 3	$32.05	$15.02
District 4	$32.05	$15.02

Duties Include:
Drywall and ceiling tile installation.

Zone Pay:
0-30 mi. free zone
>30-60 mi. + $4.00/hr.
>60mi. + $6.00/hr.

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ELECTRICIANS: INCLUDING BUILDING AUTOMATION CONTROL

	Wage	Benefit
District 1	$40.71	$18.05
District 2	$37.99	$18.32
District 3	$37.19	$17.39
District 4	$41.92	$16.32

Duties Include:
Electrical wiring; equipment and fixtures; streetlights; electrical control systems. Installation and/or adjusting of building automation controls also during testing and balancing, commissioning and retro-commissioning.

Per Diem:

District 1
45+ mi. $75/day

District 3
50+ mi. $110/day

District 4
60+ mi. $90/day

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ELEVATOR CONSTRUCTORS

	Wage	Benefit
District 1	$67.61	$47.54
District 2	$67.61	$47.54
District 3	$67.61	$47.54
District 4	$67.61	$47.54

Per Diem:
$119/day

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FLOOR LAYERS

No Rate Established

Duties Include:
Apply blocks, strips, or sheets of shock-absorbing, sound-deadening, or decorative coverings to floors.

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GLAZIERS

	Wage	Benefit
District 1	$25.32	$5.07
District 2	$25.32	$5.07
District 3	$25.32	$5.07
District 4	$24.83	$5.07

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HEATING AND AIR CONDITIONING

	Wage	Benefit
District 1	$40.07	$22.93
District 2	$40.07	$22.93
District 3	$40.07	$22.93
District 4	$40.07	$22.93

Duties Include:
Heating, air conditioning, and refrigeration mechanics and installers work on heating, ventilation, air conditioning, and refrigeration (HVACR) systems that control the temperature and air quality in buildings.

Per Diem:
$85/day

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INSULATION WORKERS-MECHANICAL(HEAT AND FROST)

	Wage	Benefit
District 1	$43.81	$22.94
District 2	$43.81	$22.94
District 3	$43.81	$22.94
District 4	$43.81	$22.94

Duties Include:
Insulate pipes, ductwork or other mechanical systems.

Travel Pay:
0-30 mi. free
31-40 mi. $30 per day
>40-50 mi. $40/day
>50-60 mi. $55/day
>60 mi. $65/day, plus: $0.66 for each mile over 60, up to $400 unless:
• Employee traveling in employee's vehicle on employer's time, then rate changes to $0.20 per mi., only for miles over 60.
• Employee traveling in company-provided vehicle with company-paid fuel, no additional travel pay mileage required.

Zone Pay:
0-30 mi. free
31-40 mi. $3.75/hr.
>40-50 mi. $5.00/hr.
>50-60 mi. $6.88/hr.
>60 mi. $8.13/hr. only if employee is commuting, if employee is staying over, Per Diem applies instead.

Per Diem:
60+ mi. $130/day; or, employer pays for lodging + $35/day for meals.

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IRONWORKERS – REINFORCING IRON AND REBAR WORKERS

	Wage	Benefit
District 1	$36.83	$25.78
District 2	$36.83	$25.78
District 3	$36.83	$25.78
District 4	$36.83	$25.78

Duties Include:
Position and secure steel bars or mesh in concrete forms in order to reinforce concrete. Use a variety of fasteners, rod-bending machines, blowtorches, and hand tools. Includes rod busters.

Per Diem:
0-45 mi. free zone
45-85 mi. $100/day
85+ mi. $150/day

Big Sky/Resort Area $200/day

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IRONWORKERS - STRUCTURAL IRON AND STEEL WORKERS

	Wage	Benefit
District 1	$36.83	$25.78
District 2	$36.83	$25.78
District 3	$36.83	$25.78
District 4	$36.83	$25.78

Duties Include:
Structural steel erection; assemble prefabricated metal buildings; cut, bend, tie, and place rebar; energy producing windmill type towers; metal bleacher seating; handrail fabrication and ornamental steel.

Per Diem:
0-45 mi. free zone
45-85 mi. $100/day
85+ mi. $150/day

Big Sky/Resort Area $200/day

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MILLWRIGHTS

	Wage	Benefit
District 1	$45.26	$23.71
District 2	$45.26	$23.71
District 3	$45.26	$23.71
District 4	$45.26	$23.71

Zone Pay:
All Districts
0-30 mi. free zone
>30-60 mi.+ $4.00/hr.
>60 mi. + $6.00/hr.

Per Diem:
$110 day or employer pays for single occupancy lodging

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PAINTERS: INCLUDING PAPERHANGERS

	Wage	Benefit
District 1	$23.10	$4.74
District 2	$23.10	$4.74
District 3	$24.83	$4.74
District 4	$24.83	$4.74

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PILEBUCKS

No Rate Established

Duties Include:
Set up crane; set up hammer; weld tips on piles; set leads; ensure piles are driven straight with the use of level or plum bob. Give direction to crane operator as to speed and direction of swing. Cut piles to grade.

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PILOT CAR DRIVERS

No Rate Established

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PLASTERERS

	Wage	Benefit
District 1	$32.05	$15.02
District 2	$32.05	$15.02
District 3	$32.05	$15.02
District 4	$32.05	$15.02

Zone Pay:
0-30 mi. free zone
>30-60 mi. + $4.00/hr.
>60mi. + $6.00/hr.

Duties Include:
All materials beyond the substrate, such as a moisture barrier, any type of drainage installation between the moisture barrier and insulation or EPS board, the attachment of the EPS board, installation of fiberglass mesh embedded in the base coat, any water-resistant coat that is applied on top of the insulation to serve as a weather barrier, and the application of the finish coat.

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PLUMBERS, PIPEFITTERS, AND STEAMFITTERS

	Wage	Benefit
District 1	$39.38	$16.26
District 2	$46.95	$19.47
District 3	$46.95	$19.47
District 4	$41.00	$21.31

Duties Include:
Assemble, install, alter, and repair pipelines or pipe systems that carry water, steam, air, other liquids or gases. Testing of piping systems, commissioning and retro-commissioning. Workers in this occupation may also install heating and cooling equipment and mechanical control systems.

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Per Diem:
District 1
30-50 miles $35.00/day
50-75 miles $45.00/day
75+ miles $100.00/day

ROOFERS

	Wage	Benefit
District 1	$34.89	$13.33
District 2	$37.26	$22.93
District 3	$33.81	$9.36
District 4	$34.24	$22.93

Duties Include:
Metal roofing, covers roofs, walls and foundations with water proofing, insulation and vapor barriers in addition to metal flashings. Roofing includes shingles, low slope membranes, metal roofs, insulation, spray foam, coatings and vapor barriers. Wall coverings include metal panels, insulated metal panels and other waterproofing or rain screen systems. Foundation systems include waterproofing and insulation. Excludes prefabricated metal buildings.

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Per Diem:
District 1
$84.00/day
District 2 & 3
Employer pays for room + $30.00/day
District 4
Employer pays for room + $25.00/day

SHEET METAL WORKERS

	Wage	Benefit
District 1	$40.07	$22.93
District 2	$40.07	$22.93
District 3	$40.07	$22.93
District 4	$38.14	$21.61

Duties Include:
Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work. Manufacture, fabrication, assembling, installation, dismantling, and alteration of all HVAC systems, air conveyor systems, and exhaust systems. All lagging over insulation and all duct lining.

Per Diem
0-45 mi. free zone
46-65 mi. $35/day
65+ mi. $155/day

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SOLAR PHOTOVOLTAIC INSTALLERS

No Rate Established

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SPRINKLER FITTERS

	Wage	Benefit
District 1	$40.82	$26.56
District 2	$41.61	$26.25
District 3	$43.23	$26.02
District 4	$44.11	$26.47

Duties Include but not limited to:
Any and all fire protection systems: Installation, dismantling, inspection, testing, maintenance, repairs, adjustments, and corrections of all fire protection and fire control systems, including both overhead and underground water mains, all piping, fire hydrants, standpipes, air lines, tanks, and pumps used in connection with sprinkler and alarm systems.

Per Diem:
District 1
100+ mi. $150/day

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TAPERS

No Rate Established

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TELECOMMUNICATIONS EQUIPMENT INSTALLERS

	Wage	Benefit
District 1	$38.89	$12.94
District 2	$25.16	$11.39
District 3	$23.90	$11.86
District 4	$23.90	$11.86

Per Diem:
Federal GSA Rate

Duties Include:
Install voice; sound; vision and data systems. This occupation includes burglar alarms, fire alarms, fiber optic systems, and video systems for security or entertainment

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TERRAZZO WORKERS AND FINISHERS

No Rate Established

Duties Include:
Finish work on hard tile, marble, and wood tile to floors, ceilings, and roof decks

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TILE AND STONE SETTERS

	Wage	Benefit
District 1	$27.80	$2.93
District 2	$29.40	$3.07
District 3	$29.60	$3.38
District 4	$31.07	$3.36

Duties Include:
Apply hard tile, stone, and comparable materials to walls, floors, ceilings, countertops, and roof decks.

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TRUCK DRIVERS

	Wage	Benefit
District 1	$25.80	$6.43
District 2	$28.08	$6.50
District 3	$31.20	$6.30
District 4	$31.25	$5.99

Truck drivers include but are not limited to:
Combination Truck & Concrete Mixer; Distributor Driver; Dry Batch Trucks; DumpTrucks & Similar Equipment; Flat Trucks; Lowboys, Four-Wheel Trailers, Float Semitrailer; Powder Truck Driver (Bulk Unloader Type); Servicemen; Service Truck Drivers, Fuel Truck Drivers, Tiremen; Trucks with Power Equipment; Truck Mechanic; Water Tank Drivers, Petroleum Product Drivers.

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SECTION 011000
SUMMARY

1.1 PART 1 - GENERAL

A. Related Documents
1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions, and other Division 1 Specification Sections, apply to this Section.

B. Project Description
1. Scope of work includes, but is not necessarily limited to, interior modifications and upgrades to failing systems that include hot/chilled water, HVAC, fire suppression, fire alarms, electrical, and IT/AV.

C. Site Information

1. See the Site Plans in the construction drawings for staging area and general phasing and gate location information. The contractor will have access to the existing property as directed by the Owner when the contract is awarded, and the agreement is signed.

D. Contracts
1. Contracts shall be under one General Contract and shall include, but not be limited to, all labor, materials, and supervision necessary to furnish and install the Work.

E. Work Sequence

1. The work will be conducted in two phases to provide the least possible interference to the activities of the Owner's personnel and activities and to accommodate Owner’s funding availability.
2. The Contractor will have access to the existing property from the date of receipt of the contract.

F. Contractor Use of Premises

1. Work on this contract is expected to be done during regular working hours Monday through Friday though access to the property is available 7 days a week. Any variation from this will require prior approval of the Consultant and Owner.
2. All work must be coordinated with MSU at all times and MSU must be informed about any work impacting farm / ranch operations 72 hours or 3 working days in advance of work being conducted and shall require MSU approval.
3. General: Limit use of the premises to construction activities in areas indicated; allow for Owner/MSU occupancy and use by the public. Confine operations to areas within property lines and public roads indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.
4. Contractor shall conduct all his work in such a manner as to minimize the inconvenience and disruption of MSU’s daily schedule, farm and ranch operations and the general public using the existing public roads.

5. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.
6. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials to the areas designated on the drawings. If additional storage is necessary, obtain and pay for such storage off-site.
7. Contractor shall establish a staging area for storage of materials and equipment.
8. The Contractor is to coordinate with MSU for the location of the job site trailer office.
9. Keep driveways and entrances serving the premises clear and available to MSU and MSU's employees, staff and visitors at all times, unless otherwise agreed by MSU. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

G. Parking and Site Access
(See also Supplemental Conditions of the Contract for Construction.)

1. No Contractor Parking Permits will be required at this site. Essential vehicles are vehicles used for delivery of equipment and tools required to be parked in close proximity to the construction area. All allowed vehicles are to be parked off the public roads out of active farming / ranching activity areas. Any necessary Personal vehicles shall be parked at the project staging area. If a driver of a vehicle not allowed to be parked at the project site must unload equipment, tools, or materials, the vehicle must be immediately thereafter move to a designated lot or leave campus.
2. Access and egress to and from the project site shall be coordinated with the Project Manager or the Rance Manager only. In cases where a different route must be used for a specific purpose, permission must be obtained from MSU. Access routes are for delivery of equipment, tools, and materials and not for parking.
3. The site Staging Areas for materials and equipment are designated on the Site Information Sheet of the Contract Documents. Staged materials and equipment must be secured on the ground surface or in trailers. Vehicles in addition to those allowed to be parked near work areas may use the staging area for overflow parking.

H. Owner Occupancy

1. Full Owner/MSU Occupancy: The Owner/MSU will occupy the site during the entire construction period. Cooperate with MSU during construction operations to minimize conflicts and facilitate MSU usage. Perform the work so as not to interfere with MSU’s operations.

I. Safety Requirements

1. General: The safety measures required by the Contract Documents are not meant to be inclusive. The Contractor shall be solely responsible for safety on a 24-hours-per-day, 7 days-per-week basis and shall take whatever additional measures are necessary to ensure the health and safety of the buildings' occupants, or pedestrians at or near the construction site and access routes and of all other persons in all areas affected by the Contractor's activities. Prior to the

start of construction, the Contractor is to submit to the Consultant, a detailed written plan specifying the safety procedures that will be followed. Include (but not by way of limitation) the following: Verbiage, size and locations of warning signs; construction sequence as related to safety; use of barricades (type and location); employee policies as related to safety; and delivery of materials as related to safety. Revise the safety plan as required during construction and resubmit to the Owner.

2. All application, material handling, and associated equipment shall conform to and be operated in conformance with OSHA safety requirements.
3. Comply with Federal, State, local, and the Owner's fire, health, and safety requirements.
4. Advise MSU whenever work is expected to be hazardous or inconvenient (including objectionable odors) to MSU's employees, students, visitors, or the building occupants.
5. Construction materials or equipment shall be placed so as not to endanger the work or prevent free access to all emergency devices or utility disconnects.
6. Maintain the proper rated fire extinguishers within easy access where power tools, sanding or other equipment is being used.
7. The Contractor shall erect and maintain, as required by law, conditions and progress of the work, warning signs, barricades and other reasonable safeguards for safety and protection.

J. Existing Premises Condition

1. The Contractor is responsible for adequately documenting in photos the existing condition of the premises, to include external road surfaces, curbing and landscaped areas, specifically the cleanliness of areas. Any damage to the premises which is found after construction and is not so documented will be the responsibility of the Contractor to repair or replace.

K. Discrepancies in the Documents

1. The Contractor shall bring any discrepancies between any portions of the drawings and specifications to the attention of the Owner and the Consultant in writing. The Owner and Consultant shall review the discrepancy and clarify the intent desired in the Contract Documents. Unless specifically directed otherwise, the Contractor shall be obligated to provide the greater quantity or quality without any change in contract sum or time.

END OF SECTION 011000

SECTION 012000
PRICE AND PAYMENT
PROCEDURES

1.1 GENERAL

A. Related Documents
1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

B. Summary

1. This Section specified administrative and procedural requirements governing the Contractor's Applications for Payment.
2. The Contractor's Construction Schedule and Submittal Schedule are included in Section "Submittals".

C. Schedule of Values

1. Coordinate preparation of the Schedule of Values, Form 100, with preparation of the Contractor's Construction Schedule.
2. Each prime Contractor shall coordinate preparation of its Schedule of Values for its part of the work with preparation of the Contractor's Construction Schedule.
3. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:

a. Contractor's construction schedule
b. Application for Payment form
c. List of subcontractors
d. Schedule of allowances
e. Schedule of alternates
f. List of products
g. List of principal suppliers and fabricators
h. Schedule of submittals
i. Submit the Schedule of Values to the Architect at the earliest feasible date, but in no case later than seven (7) days before the date scheduled for submittal of the initial Application for Payment.
j. Sub-Schedules: Where the work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

4. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.

a. Identification: Include the following project identification on the Schedule of Values:

1) Project name
2) Name of the Architect
3) Project number (PPA No.)
4) Contractor's name and address
5) Date of submittal

b. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

1) Generic name
2) Related specification section
3) Name of subcontractor
4) Name of manufacturer or fabricator
5) Name of supplier
6) Change Orders (numbers) that have affected value
7) Dollar value

a) Percentage of Contract Sum in the nearest one-hundredth percent, adjusted to total 100%

c. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

d. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

e. For each part of the work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that art of the work.

5. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

a. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.

6. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

D. Applications for Payment

1. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.
2. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
3. Payment Application Forms: Use Montana Form 101 as the form for Application for Payment.
4. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

a. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
b. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

5. Transmittal: Submit one (1) executed copy of each Application for Payment to the Architect by means ensuring receipt within 24 hours, including waivers of lien and similar attachments, when required.

   a. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Architect.

6. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

   a. List of subcontractors
   b. Schedule of Values

      1) Contractor's Construction Schedule (preliminary if not final)

   c. Copies of building permits

      1) Copies of authorizations and licenses from governing authorities for performance of the work

   d. Certificates of insurance and insurance policies (submitted with Contract)
   e. Performance and payment bonds (submitted with Contract if required)

7. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the work.
8. Administrative actions and submittals that shall proceed or coincide with this application include:

   a. Occupancy permits and similar approvals
   b. Warranties (guarantees) and maintenance agreements
   c. Test/adjust/balance records
   d. Maintenance instructions
   e. Meter readings
   f. Start-up performance reports

      1) Change-over information related to Owner's occupancy, use, operation and maintenance.

   g. Final cleaning

      1) Application for reduction of retainage, and consent of surety

9. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final Application for Payment include the following:

   a. Completion of project closeout requirements

      1) Completion of items specified for completion after Substantial Completion

   b. Assurance that unsettled claims will be settled

      1) Assurance that work not complete and accepted will be completed without undue delay
      2) Transmittal of required project construction records to Owner

END OF SECTION 01200

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

A. Related Documents
   1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions and *Instructions to Bidders*.

B. Substitution Procedures
   1. Substitutions include changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by the Contractor.
   2. Substitution Requests: Submit three copies of each request on MSU Substitution Request Form 099 for each consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

      a. Submit requests in accordance with *Instructions to Bidders*.
      b. Identify product to be replaced and show compliance with requirements for substitutions. Include a detailed comparison of significant qualities of proposed substitution with those of the Work specified, a list of changes needed to other parts of the Work required to accommodate proposed substitution, and any proposed changes in the Contract Sum or the Contract Time should the substitution be accepted.

C. Architect will review proposed substitutions and notify Contractor of their acceptance or rejection. If necessary, Architect will request additional information or documentation of evaluation.

   1. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

D. Do not submit unapproved substitutions on Shop Drawings or other submittals.

END OF SECTION 012500

SECTION 013000

SUBMITTALS

1.1 GENERAL

A. Related Documents

1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

B. Summary

1. This Section specifies administrative and procedural requirements for submittals required for performance of the work, including:

   a. Contractor's construction schedule
   b. Submittal schedule
   c. Daily construction reports
   d. Shop Drawings
   e. Product data
   f. Samples

   Note: All Submittals are to be both print and electronic.

2. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

   a. Permits
   b. Applications for Payment
   c. Performance and payment bonds
   d. Insurance certificates
   e. List of Subcontractors

3. The Schedule of Values submitted is included in Section "Applications for Payment".
4. Inspection and test reports are included in Section "Quality Requirements".
5. Unless otherwise instructed by the Owner all submittals shall be directed to Architect/Engineer Consultant of Record. The Contractor’s construction schedule, submittal schedule and daily construction reports shall be directed to the Consultant’s representative, the State of Montana’s representative and MSU’s representative. Shop drawings, product data and samples shall be directed to the Consultant’s representative.

C. Submittal Procedures

1. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

   a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

b. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.

1) The Consultant reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

c. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

1) Allow two (2) weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Consultant will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
2) If an intermediate submittal is necessary, process the same as the initial submittal.
3) Allow two (2) weeks for reprocessing each submittal.
4) No extension of contract time will be authorized because of failure to transmit submittals to the Consultant sufficiently in advance of the work to permit processing.

2. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

a. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
b. Include the following information on the label for processing and recording action taken.

1) Project name and PPA Number
2) Date
3) Name and address of Consultant
4) Name and address of Contractor
5) Name and address of Subcontractor
6) Name and address of supplier
7) Name of manufacturer

a) Number and title of appropriate Specification Section
b) Drawing number and detail references, as appropriate

3. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Consultant using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

a. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include

Contractor's certification that information complies with Contract Documents requirements.

b. Transmittal Form: Contractor's standard form.

D. Contractor's Construction Schedule

1. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit both in print and electronically within thirty (30) days of the date established for "Commencement of the Work".

   a. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the work as indicated in the "Schedule of Values".
   b. Within each time bar indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate actual completion.
   c. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
   d. Secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the work.
   e. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other schedules.
   f. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Consultant's procedures necessary for certification of Substantial Completion.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.
3. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the work. Indicate where each element in an area must be sequenced or integrated with other activities.
4. Cost Correlation: At the head of the schedule, provide a two (2) item cost correlation line, indicating "pre-calculated" and "actual" costs. On the line show dollar-volume of work performed as of the dates used for preparation of payment requests.

   a. Refer to Section "Price and Payment Procedures" for cost reporting and payment procedures.

5. Distribution: Following response to the initial submittal, print and distribute copies to the Consultant, Owner, subcontractors, and other parties required to comply with scheduled dates. Transmit electronically and post copies in the project meeting room and temporary field office.

   a. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have

completed their assigned portion of the work and are no longer involved in construction activities.

6. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule electronically and in print concurrently with report of each meeting.

E. Submittal Schedule

1. After development and acceptance of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the schedule within ten (10) days of the date required for establishment of the Contractor's construction schedule.

   a. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products, as well as the Contractor's construction schedule.
   b. Prepare the schedule in chronological order; include submittals required during the first thirty (30) or sixty (60) days of construction. Provide the following information:

      1) Scheduled date for the first submittal
      2) Related section number
      3) Submittal category
      4) Name of subcontractor
      5) Description of the part of the work covered
      6) Scheduled date for resubmittal
         a) Scheduled date the Consultant's final release or approval

2. Distribution: Following response to initial submittal, print and distribute copies to the Consultant, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.

   a. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in construction activities.

3. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

F. Daily Construction Reports

1. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Consultant at weekly intervals:

   a. List of subcontractors at the site
   b. Approximate count of personnel at the site
   c. High and low temperatures, general weather conditions
   d. Accidents and unusual events
   e. Meetings and significant decisions

f. Stoppages, delays, shortages, losses
g. Meter readings and similar recordings
h. Emergency procedures
i. Orders and requests of governing authorities
j. Change Orders received, implemented
k. Services connected, disconnected
l. Equipment or system tests and start-ups
m. Partial completions, occupancies
n. Substantial Completions authorized

G. Shop Drawings

1. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the project is not considered Shop Drawings.
2. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:

a. Dimensions
b. Identification of products and materials included
c. Compliance with specified standards
d. Notation of coordination requirements
e. Notation of dimensions established by field measurement
f. Sheet Size: Except for templates, patterns and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2" x 11", but no larger than 36" x 48".
g. Submittal: Submit electronically and in print for the Consultant's review; Consultant’s comments will be returned electronically.

1) One (1) of the prints returned shall be marked-up and maintained as a "Record Document".

h. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

3. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

a. Preparation of coordination drawings is specified in section "Project Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
b. Submit coordination drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.

H. Product Data

1. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's

installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings".

a. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

1) Manufacturer's printed recommendations
   a) Compliance with recognized trade association standards
   b) Compliance with recognized testing agency standards

2) Application of testing agency labels and seals
   a) Notation of dimensions verified by field measurement
3) Notation of coordination requirements

b. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

c. Preliminary Submittal: Submit a preliminary single-copy of Product Data where selection of options is required.

d. Submittals: Submit two (2) copies of each required submittal; submit four (4) copies where required for maintenance manuals. The Consultant will retain one (1), and will return the other marked with action taken and corrections or modifications required.

1) Unless non-compliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

e. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

1) Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
2) Do not permit use of unmarked copies of Product Data in connection with construction.

I. Samples

1. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

a. Mount, display, or package samples in the manner specified to facilitate review of qualities indicated. Prepare samples to match the Consultant's sample. Include the following:

1) Generic description of the sample
2) Sample source
3) Product name or name of manufacturer

4) Compliance with recognized standards
5) Availability and delivery time

2. Submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture, or other characteristics are inherent in the material or product represented, submit multiple units (not less than three (3), that show approximate limits of the variations.
b. Refer to other specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
c. Refer to other sections for samples to be returned to the Contractor for incorporation in the work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.

3. Preliminary Submittals: Where samples are for selection of color, pattern, texture, or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.

a. Preliminary submittals will be reviewed and returned with the Consultant's mark indicating selection and other action.

4. Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit three (3) sets; one (1) will be returned marked with the action taken.

a. Maintain sets of samples, as returned, at the project site, for quality comparisons throughout the course of construction.

1) Unless non-compliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
2) Sample sets may be used to obtain final acceptance of the construction associated with each set.

5. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the work. Show distribution on transmittal forms.

a. Field samples specified in individual sections are special types of samples. Field samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the work will be judged.

1) Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

J. Consultant's Action

1. Except for submittals for record, information, or similar purposes, where action and return is required or requested, the Consultant will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.
2. Action Stamp: The Consultant will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

    a. Final-But-Restricted Release: When submittals are marked "Make Corrections Noted", that part of the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
    b. Returned for Resubmittal: When submittal is marked "Revise and Resubmit", do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

        1) Do not permit submittals marked "Revise and Resubmit" to be used at the project site, or elsewhere where work is in progress.

    c. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action not Required".

END OF SECTION 013000

SECTION 013100
PROJECT COORDINATION

1.1 GENERAL

A. Related Documents
1. Drawings and general provisions of Contract, including General Conditions and Supplemental Conditions and other Division1 Specification Sections, apply to this Section.

B. Summary
1. This section specifies administrative and supervisor requirements necessary for project coordination including, but not necessarily limited to:
   a. Coordination
   b. Administrative and supervisory personnel
   c. General installation provisions
   d. Cleaning and protection
2. Field Engineering is included in Section "Field Engineering".
3. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings".
4. Requirements for Contractor's Construction Schedule are included in Section "Submittals".

C. Coordination
1. Coordination: Coordinate construction activities included under various sections of these specifications to assure efficient and orderly installation of each part of the work. Coordinate construction operations included under different sections of the specifications that are dependent upon each other for proper installation, connection, and operation.
   a. Provide access to work at all times for inspections by Owner and authorized representatives.
   b. Provide safe working conditions and protection of completed work.
   c. Provide barricades and signs.
   d. Where installation of one part of the work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
   e. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
   f. Make adequate provisions to accommodate items scheduled for later installation.
   g. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
      1) Prepare similar memoranda for the Owner and separate Contractors where coordination of their work is required.
2. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

a. Notify Facilities Services or Campus Planning, Design and Construction of any expected disruptions in service or changes in construction schedule at least 72 hours (3 working days) in advance.
b. Preparation of schedules.
c. Installation and removal of temporary facilities.
d. Delivery and processing of submittals.
e. Progress meetings.
f. Project close-out activities.

3. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
a. Salvage materials and equipment involved in performance of, but not actually incorporated in, the work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

D. Submittals
1. Coordinated Drawings: Prepare and submit coordination drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
a. Show the interrelationship of components shown on separate shop drawings.
b. Indicate required installation sequences.
c. Comply with requirements contained in Section "Submittals".
d. Section "Basic Electrical Requirements" for specific coordination drawing requirements for mechanical and electrical installations.
2. Staff Names: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers. Post copies of the list in the project meeting room, the temporary field office, and each temporary telephone.

1.2 PROJECT MEETINGS

A. Related Documents
1. Drawings and general provisions of the Contract, including General and Supplementary General Conditions and other Division 1 Specification Sections, apply to this Section.

B. Summary
1. This section specifies administrative and procedural requirements for project meetings including but not limited to:
a. Pre-construction conference
b. Pre-installment conferences
c. Coordination meetings
d. Progress meetings

C. Pre-construction Conference
1. Schedule a pre-construction conference and organizational meeting.
a. Hold meeting at the project site or other convenient location and prior to commencement of construction activities, including the moving of

equipment on to the site. Conduct the meeting to review responsibilities and personnel assignments.

2. Attendees: The Owner, Consultant and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work. Both the Contractor and the Contractor's job foremen shall attend the meeting, along with all subcontractors.
3. Agenda: Discuss items of significance that could affect progress including such topics as:
    a. Tentative construction schedule
    b. Critical work sequencing
    c. Designation of responsible personnel
    d. Procedures for processing field decisions and Change Orders
    e. Procedures for processing Applications for Payment
    f. Distribution of Contract Documents
    g. Submittal of Shop Drawings, Product Data and Samples
    h. Preparation of record documents
    i. Use of the premises
    j. Office, work and storage areas
    k. Equipment deliveries and priorities
    l. Safety procedures
    m. First aid
    n. Security
    o. Housekeeping
    p. Working hours

D. Pre-Installation Conferences
1. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Consultant of scheduled meeting dates.
2. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
    a. Contract Documents
    b. Options
    c. Related Change Orders
    d. Purchases
    e. Deliveries
    f. Shop Drawings, Product Data and quality control samples
    g. Possible conflicts
    h. Compatibility problems
    i. Time schedules
    j. Weather limitations
    k. Manufacturer's recommendations
    l. Compatibility of materials
    m. Acceptability of substrates
    n. Temporary facilities
    o. Space and access limitations
    p. Governing regulations

q. Safety
r. Inspection and testing requirements
s. Required performance results
t. Recording requirements
u. Protection

3. The Consultant will record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Consultant.
4. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of work and reconvene the conference at the earliest feasible date.

E. Coordination Meeting
1. Conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.
2. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.
3. The Consultant will record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

F. Progress Meetings
1. Conduct progress meetings at the project site at regularly scheduled intervals. Coordinate with the Owner and Consultant of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.
2. Attendees: In addition to representatives of the Owner and Consultant, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress.
3. Agenda: Visit job site to raise specific pending issues prior to meeting. Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.
a. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the contract time.
b. Review the present and future needs of each entity present, including such items as:
1) Interface requirements
2) Time
3) Sequences
4) Deliveries
5) Off-site fabrication problems
6) Access
7) Site utilization

8) Temporary facilities and services
9) Hours of work
10) Hazards and risks
11) Housekeeping
12) Quality and work standards
13) Change Orders
14) Documentation of information for payment requests

4. Reporting: The Consultant shall distribute printed and electronic copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
   a. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

1.3 PRODUCTS (NOT APPLICABLE)

1.4 EXECUTION

A. General Installation Provisions
1. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
2. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
3. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
4. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.
5. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Consultant for final decision.
6. Recheck measurements, quantities and dimensions, before starting each installation.
7. Install each component during weather conditions and project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
8. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
9. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated and in compliance with accessibility requirements. Refer questionable mounting height decisions to the Consultant for final decision.

B. Cleaning and Protection
1. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

2. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
3. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
    a. Excessive static or dynamic loading
    b. Excessive internal or external pressures
    c. Excessively high or low temperatures
    d. Thermal shock
    e. Excessively high or low humidity
    f. Air contamination or pollution
    g. Water or ice
    h. Solvents
    i. Chemicals
    j. Light
    k. Radiation
    l. Puncture
    m. Abrasion
    n. Heavy traffic
    o. Soiling, staining and corrosion
    p. Bacteria
    q. Rodent and insect infestation
    r. Combustion
    s. Electrical current
    t. High speed operation
    u. Improper lubrication
    v. Unusual wear or other misuse
    w. Contact between incompatible materials
    x. Destructive testing
    y. Misalignment
    z. Excessive weathering
        aa. Unprotected storage
        ab. Improper shipping or
        ac. handling Theft
        ad. Vandalism

END OF SECTION 013100

SECTION 014000
QUALITY REQUIREMENTS

1.1 GENERAL

A. RELATED DOCUMENTS

1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions and other Division-1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section specifies administrative and procedural requirements for quality control services.
2. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.
3. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
4. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

    a. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
    b. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
    c. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. RESPONSIBILITIES

1. Contractor Responsibilities: The Contractor shall provide inspections, tests and similar quality control services, specified in individual Specification Sections and required by governing authorities, except where they are specifically indicated to be the Owner's responsibility, or are provided by another identified entity; these services include those

    a. Services specified to be performed by an independent agency and not by the Contractor. Costs for these services shall be included in the Contract Sum.
    b. The Contractor shall employ and pay an independent agency, to perform specified quality control services.
    c. The Owner will engage and pay for the services of an independent agency

to perform inspections and tests specified as the Owner's responsibility. Payment for these services will be made by the Owner.

d. Where the Owner has engaged a testing agency or other entity for testing and inspection of a part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless otherwise agreed in writing with the Owner.

2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services provide unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

   a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

3. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Associated services required include but are not limited to:

   a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
   b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
   c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
   d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
   e. Security and protection of samples and test equipment at the Project site.

4. Owner Responsibilities: The Owner will provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor, except where they are specifically indicated as the Contractor's responsibility or are provided by another identified entity. Costs for these services are not included in the Contract Sum.

   a. The Owner will employ and pay for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.

5. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

   a. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

b. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
c. The agency shall not perform any duties of the Contractor.

6. Coordination: The Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

D. SUBMITTALS

1. The independent testing agency shall submit a certified written report and electronic copy of each inspection, test or similar service, to the Architect, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, submit a certified written report of each inspection, test or similar service through the Contractor, in duplicate.

a. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
b. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

1) Date of issue
2) Project title and number
3) Name, address and telephone number of testing agency
4) Dates and locations of samples and tests or inspections
5) Names of individuals making the inspection or test
6) Designation of the Work and test method
7) Identification of product and Specification Section
8) Complete inspection or test data
9) Test results and in interpretations of test results
10) Ambient conditions at the time of sample-taking and testing
11) Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements
12) Name and signature of laboratory inspector
13) Recommendations on retesting

DI. QUALITY ASSURANCE

1. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
2. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State of Montana.

1.2 PRODUCTS (NOT APPLICABLE)

1.3 EXECUTION

A. GENERAL

1. Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.
2. Protect construction exposed by or for quality control service activities, and protect repaired construction.
3. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 014000

SECTION 015000
TEMPORARY FACILITIES AND UTILITIES

1.1 GENERAL

A. RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General Conditions and Supplemental Conditions and other Division-1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.
2. Temporary utilities required may include but are not limited to:

   a. Telephone service
   b. Electric Service
   c. Water
   d. Natural gas
   e. Sewer

3. Temporary construction and support facilities required may include but are not limited to:

   a. Field offices and storage sheds.
   b. Sanitary facilities, including drinking water
   c. Temporary Project identification signs and bulletin boards
   d. Waste Disposal services
   e. Construction aids and miscellaneous services and facilities

4. Security and protection facilities required include but are not limited to:

   a. Temporary Security Fencing
   b. Temporary fire protection

   b. Barricades, warning signs, lights
   c. Environmental protection

C. QUALITY ASSURANCE

1. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:

   a. Building Code requirements
   b. Health and safety regulations
   c. Utility company regulations
   d. Police, Fire Department and Rescue Squad rules
   e. Environmental protection regulations

2. Standards: Comply with NFPA Code 241, "Building Construction and

Demolition Operations" and ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".

D. PROJECT CONDITIONS

1. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

1.2 PRODUCTS

A. MATERIALS

1. General: Provide new materials; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
2. Water: Provide potable water approved by local health authorities.
3. Open-Mesh Fencing: Provide 11-gage, galvanized 2-inch, chain link fabric fencing 6-feet high with galvanized barbed wire top strand and galvanized steel pipe posts, 1 1/2" I.D. for line posts and 2-1/2" I.D. for corner posts.

B. EQUIPMENT

1. General: Provide new equipment; if acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
2. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.
3. Electrical Outlets: Provide properly configured NEA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
4. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.
5. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
6. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.
7. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

9. First Aid Supplies: Comply with governing regulations.
10. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

    a. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

1.3 EXECUTION

A. INSTALLATION

1. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work and Owner's operations. Relocate and modify facilities as required.
2. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

B. TEMPORARY UTILITIES

1. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period. Provide cellular telephone, operational and on site at all times.

C. TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

1. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access and minimal interruption to Owner's operations.

    a. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

2. Field Offices: The Contractor, at his option, shall provide insulated, weather tight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip offices as follows:

    a. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table and plan rack and a 6-shelf bookcase.
    b. Equip with a water cooler and private toilet complete with water closet, lavatory and mirror-medicine cabinet unit.

3. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved,

including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

4. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

    a. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

5. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.
6. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

    a. Provide safety showers, eye-wash fountains and similar facilities for convenience, safety and sanitation of personnel.

7. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units, including paper supply.

    a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7 to 13 deg C).

8. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg. F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner. Do not use University trash containers for any reason.

D. SECURITY AND PROTECTION FACILITIES INSTALLATION

1. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

    (a) Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

2. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
3. Open-Mesh Fencing: Provide 11-gage, galvanized 2-inch, chain link fabric fencing 6-feet high with galvanized barbed wire top strand and galvanized steel

pipe posts, 1 1/2" I.D. for line posts and 2-1/2" I.D. for corner posts.

4. Barricades, Warning Signs and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

5. Do not remove temporary security and protection facilities until Substantial Completion, or longer as requested by the Architect.

6. Temporary Fire Protection: Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations."

   a. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than on extinguisher on each floor at or near each usable stairwell.
   b. Store combustible materials in containers in fire-safe locations.
   c. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
   d. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

7. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

E. OPERATION, TERMINATION AND REMOVAL

1. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
2. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
3. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

   a. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

END OF SECTION 015000

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to this section.

1.2 SECTION REQUIREMENTS

A. Provide products of same kind from a single source. The term "product" includes the terms "material," "equipment," "system," and similar terms.

B. Deliver, store, and handle products according to manufacturer's written instructions, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Inspect products at time of delivery for compliance with the Contract Documents and to ensure items are undamaged and properly protected.

C. Product Substitutions: Reasonable and timely requests for substitutions will be considered. Substitutions include products and methods of construction differing from that required by the Contract Documents and proposed by Contractor after award of Contract. Substitutions only al-lowed for products when more than one manufacturer is indicated.

1. Submit two (2) copies of each request for product substitution. Identify product to be re-placed and provide complete documentation showing compliance of proposed substitu-tion with applicable requirements. Include a full comparison with the specified product, a list of changes to other Work required to accommodate the substitution, and any pro-posed changes in Contract Sum or Contract Time should the substitution be accepted.
2. Submit requests for product substitution in time to permit processing of request and sub-sequent Submittals, if any, sufficiently in advance of when materials are required in the Work. Do not submit unapproved substitutions on Shop Drawings or other submittals.
3. Owner will review the proposed substitution and notify Contractor of its acceptance or rejection.

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. Provide products that comply with the Contract Documents, are undamaged, and are new at the time of installation.

1. Provide products complete with accessories, trim, finish, and other devices and compo-nents needed for a complete installation and the intended use and effect.

B. Select products as follows:

1. Where only a single product or manufacturer is named, provide the item indicated. No substitutions will be permitted.
2. Where two or more products or manufacturers are named, provide one of the items indi-cated. No substitutions will be permitted.
3. Where products or manufacturers are specified by name, accompanied by the term "or equal," provide the named item or comply with provisions concerning "product substitu-tions" to obtain approval for use of an unnamed product or manufacturer.
4. Where a product is described with required characteristics, with or without naming a brand or trademark, provide a product that complies with those characteristics and other Contract requirements.
5. Where compliance with performance requirements is specified, provide products that comply and are recommended in writing by the manufacturer for the application.
6. Where compliance with codes, regulations, or standards, is specified, select a product that complies with the codes, regulations, or standards referenced.

C. Unless otherwise indicated, Owner will select color, pattern, and texture of each product from manufacturer's full range of options.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 016000

SECTION 173000 EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.

1.3 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Consultant of locations and details of cutting and await directions from Consultant before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or those results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Consultant's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Consultant for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a written and email request for information to Consultant.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, promptly notify Consultant by email and in writing.

1. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
2. Inform installers of lines and levels to which they must comply.
3. Check the location, level and plumb, of every major element as the Work progresses.
4. Notify Consultant when deviations from required lines and levels exceed allowable tolerances.

B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Consultant.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Consultant, and in compliance with accessibility requirements.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond- core drill.
4. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste.
4. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

1. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

H. Clean and provide maintenance on completed construction as frequently as necessary through

the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017400
WARRANTIES AND BONDS

1.1 GENERAL

A. RELATED DOCUMENTS

1. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division-1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

   a. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
   b. General closeout requirements are included in Section "Project Closeout."
   c. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions-2 through -16.
   d. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

2. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. DEFINITIONS

1. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
2. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

D. WARRANTY REQUIREMENTS

1. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
2. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
3. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with

requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.

4. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

    a. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

E. SUBMITTALS

1. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

    a. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within fifteen days of completion of that designated portion of the Work.

2. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate items and identification, ready for execution by the required parties. Submit a draft to the Owner through the Architect for approval prior to final execution.

    a. Refer to individual Sections of Divisions-2 through -16 for specific content requirements, and particular requirements for submittal of special warranties.

3. Forms of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.

    a. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a

typed description of the product or installation, including the name or the product, and the name, address and telephone number of the installer.

b. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the Project title or name, and the name of the Contractor.

2. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.2 PRODUCTS (NOT APPLICABLE)

1.3 EXECUTION

A. SCHEDULE OF WARRANTIES

1. Schedule: Provide warranties and bonds on products and installations as specified in the appropriate Sections.

END OF SECTION 017400

SECTION 017419
WASTE MANAGEMENT

PART 1 - GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

Owner requires that this project generate the least amount of trash and waste possible. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills
or by incineration and shall be recycled:

Aluminum and plastic beverage containers.
Corrugated cardboard.
Wood pallets.
Clean dimensional wood: May be used as blocking or furring.
Land clearing debris, including brush, branches, logs, and stumps.
Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

Methods of trash/waste disposal that are **not** acceptable are:
Burning on the project site.
Burying on the project site.
Dumping or burying on other property, public or private. Other illegal dumping or burying.

Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, State and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 DEFINITIONS

Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
Non-hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
Return: To give back reusable items or unused products to vendors for credit.

Reuse: To reuse a construction waste material in some manner on the project site.
Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
Toxic: Poisonous to humans either immediately or after a long period of exposure.
Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

1.3 WASTE MANAGEMENT PLAN IMPLEMENTATION

Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and the Architect.
Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
Meetings: Discuss trash/waste management goals and issues at project meetings, including the Pre-bid meeting, Pre-construction meeting and regular job-site meetings.
Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.

As a minimum, provide:

Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
Separate dumpsters for each category of recyclable.
Recycling bins at worker lunch area.

Provide containers as required.
Provide adequate space for pick-up and delivery and convenience to subcontractors. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 017419

SECTION 017700
PROJECT CLOSEOUT

1.1 GENERAL

A. RELATED DOCUMENTS
1. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division-1 Specification Sections, apply to this Section.

B. SUMMARY
1. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
   a. Inspection procedures
   b. Project record document submittal
   c. Operating and maintenance manual submittal
   d. Submittal of warranties
   e. Final cleaning
   f. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions - 2 through - 33.

C. SUBSTANTIAL COMPLETION
1. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
   a. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
      1) If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
   b. Advise Owner of pending insurance change-over requirements.
   c. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
   d. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
   e. See the *Supplemental Conditions of the Contract for Construction* 3.11 for Documentation and As-Built Conditions, and the *Project Closeout Checklist*: Contractor Requirements. Submit maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.
   f. Deliver tools, spare parts, extra stock, and similar items.
   g. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
   h. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

2. Inspection Procedures: On receipt of a request for inspection, the Consultant will either proceed with inspection or advise the Contractor of unfilled requirements. The Consultant will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
    a. The Consultant will repeat inspection when requested and assured that the Work has been substantially completed.
    b. Results of the completed inspection will form the basis of requirements for final inspection.

D. FINAL ACCEPTANCE
1. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
    a. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
    b. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
    c. Submit a certified copy of the Consultant's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Consultant.
    d. Submit consent of surety to final payment.
    e. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
2. Re-inspection Procedure: The Consultant will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Consultant.
    a. Upon completion of re-inspection, the Consultant will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
    b. If necessary, re-inspection will be repeated.

E. RECORD DOCUMENT SUBMITTALS
1. See also the *Supplemental Conditions of the Contract for Construction* 3.11 for Documentation and As-Built Conditions, and the *Project Closeout Checklist*: Contractor Requirements.
2. General: Do not use record documents (red-line markups) for construction purposes; protect from deterioration and loss in a secure, fire- resistive location; provide access to record documents for the Consultant's reference during normal working hours.
3. Record Drawings (Red-lined): Maintain two clean, undamaged sets of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the sets to show the red-line changes during the course of construction with actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop

Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

a. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
b. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
c. Note related Change Order numbers where applicable.
d. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

4. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.
   a. Upon completion of the Work, submit record Specifications to the Consultant for the Owner's records.
5. Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark up of record drawings and Specifications.
   a. Upon completion of mark-up, submit (3) complete sets of record Product Data to the Consultant for the Owner's records.
6. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Consultant and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area
7. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Consultant for the Owner's records.
8. Maintenance Manuals: Provide one (1) draft copy for review. Provide **one (1)** final paper copy and one electronic pdf file prior to final completion. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 3-inch, 3 ring vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include the following types of information; and others as specified in other Divisions:
   a. Emergency instructions
   b. Spare parts list
   c. Copies of warranties
   d. Wiring diagrams

e. Recommended "turn around" cycles
f. Inspection procedures
g. Shop Drawings and Product Data
h. Fixture lamping schedule
i. List of final color and material selections

F. WARRANTIES AND BONDS

1. SUMMARY

a. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer’s standard warranties on products and special warranties.

1) Refer to the General Conditions and Supplemental Conditions for terms of the Contractor's special warranty of workmanship and materials.
2) General closeout requirements are included in Section "Project Closeout."
3) Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions-2 through -16.
4) Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

b. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
c. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

2. DEFINITIONS

a. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
b. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

G. WARRANTY REQUIREMENTS

a. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
b. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
c. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying

with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.

d. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
   1) Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

e. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

4. SUBMITTALS

a. Submit written warranties to the Consultant prior to the date certified for Substantial Completion. If the Consultant's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Consultant.
   1) When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Consultant within fifteen days of completion of that designated portion of the Work.

b. Forms of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

c. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
   1) Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name or the product, and the name, address and telephone number of the installer.
   2) Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the Project title or name, and the name of the Contractor.

d. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.2 EXECUTION

A. CLOSEOUT PROCEDURES

1. Functional Demonstration: Demonstrate proper operation of all systems to Consultants and Owners representative prior to request for substantial completion. Coordinate schedule with Consultant.
2. Operating and Maintenance Instructions: Provide two (2) duplicate training sessions for each MSU trade group responsible for systems installed under this project. Coordinate schedule with Owner. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
    a. Maintenance manuals
    b. Record documents
    c. Spare parts and materials
    d. Tools
    e. Lubricants
    f. Fuels
    g. Identification systems
    h. Control sequences
    i. Hazards
    j. Cleaning
    k. Warranties and bonds
        1) Maintenance agreements and similar continuing commitments

END OF SECTION 017700

SECTION 017823
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 A.RELATED DOCUMENTS

A. General provisions of Contract, including General and Supplemental Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Operation manuals for systems, subsystems, and equipment.
3. Product maintenance manuals.
4. Systems and equipment maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

2. One paper copy and one electronic pdf. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will deliver copies to the Owner.

C. Manual Submittal: Submit each manual in DRAFT in PDF format form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments. PROVIDE PAPER AND PDF OF FINAL APPROVED MANUALS

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily

navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: These binders are sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and oversize sheets will need to be folded to 8x11.5.

a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Precautions against improper use.
9. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.

7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

CI. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

CII. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.3 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

PART 4 - MATERIAL AND FINISHES MAINTENANCE MANUAL

A. General: Incorporate as part of the O& M Manuals. Material and finishes to the Architect/Engineer for approval and distribution. Provide one section for architectural products, including applied materials and finishes, and a second section for products designed for moisture protection and products exposed to the water.

1. Refer to individual specification sections for additional requirements on the care and maintenance of materials and finishes

B. Architectural Products, Applied Materials and Finishes: Provide complete manufacturers data and instructions on the care and maintenance of architectural products, including applied materials and finishes.

C. Manufacturers Data: Provide complete information on architectural products, including but not limited to the following items, as applicable:
1. Manufacturer’s catalog number
2. Size
3. Material composition
4. Color texture reordering information for specially manufactured products
5. Manufacturer and supplier/installers contact information
6. Warranty terms

D. Care and Maintenance Instruction: Provide complete information on the care and maintenance of architectural products, including the manufacturer’s recommendations for the types of cleaning agents to be used and the methods of cleaning. In addition, provide information regarding cleaning agents and methods which could prove detrimental to the product. Include the manufacturer’s recommended schedule for cleaning and maintenance.

E. Manufacturer's Data: Provide complete manufacturer's data giving detailed information including, but not limited to the following, as applicable:
   1. Applicable standards
   2. Chemical composition
   3. Installation details
   4. Inspection procedures
   5. Maintenance information
   6. Repair procedures

F. Schedule: Provide complete information in the materials and finishes manual on products specified in the following sections: (To be determined with Owner)

G. Color Schedule: Provide complete information on MSU CPDC provided electronic spreadsheet form, to include manufacturer's name and number, location, item and surface of all painted, stained or treated material, surface or piece of equipment.

END OF SECTION 017823

SECTION 017839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. See also General Conditions and Supplemental Conditions of the Contract for Construction.

B. **See the *Supplemental Conditions of the Contract for Construction* 3.11 for Documentation and As-Built Conditions, and the *Project Closeout Checklist*: Contractor Requirements**

C. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

D. Related Requirements:

1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings (Redline Markups): Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

a. Draft Submittal:

1) Submit PDF electronic files of scanned record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one set(s) of prints.
3) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name and PPA Number.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

4. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

1. System Demonstration:
    a. General:
        i. The system demonstration is a functional test of systems to determine whether they are substantially complete and operating as specified. Systems are to be tested and confirmed to be operating properly by the contractor prior to the Demonstration.
        ii. Where initial Demonstration Session uncovers substantial deficiencies that require more than one Demonstration Session, Contractor shall reimburse Owner for personnel costs associated with performing subsequent Sessions.
    b. Systems to be Tested:
        i. All systems installed and/or provided under the project to have functional testing.
    c. Attendance:
        i. The system demonstration is to be provided by trained representatives that are familiar with the systems, and can operate systems as required to test and verify proper function. The Engineer and Owner's representatives will be present to document performance and/or deficiencies. The General Contractor or others may attend if desired.
        ii. Individual testing sessions (modules) shall be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system. MSU trades groups and systems typically involved in testing are:
            (1) Electricians
            (2) Heating Plant (Hydronic and steam heating systems, controls)
            (3) Plumbers (Plumbing, gas-fired heating, process piping systems)
            (4) Refrigeration (Refrigeration, chilled water, packaged cooling systems)
    d. Schedule:
        i. Contractor to coordinate time requirements and dates with Owner and Engineer. Begin scheduling with sufficient time prior to desired Substantial Completion date to allow all parties to work into schedule, and for deficiencies to be completed prior to desired Substantial Completion date. Demonstration is to be provided prior to, and separate from, training.

2. Training:
    a. General:
        i. The system training is intended to familiarize the Owner's operating and maintenance staff with all systems requiring maintenance. Training is to be provided after the systems are in place and operational, after issues noted during the Demonstration have been resolved, and before final acceptance.
    b. Systems Requiring Training:
        i. All systems installed and/or provided under the project are to have training.
    c. Attendance:
        i. Training is to be provided by trained representatives that are familiar with the system's operation and maintenance requirements. Individual training sessions (modules) shall be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system. MSU trades groups and systems typically requiring training are:
            (1) Electricians

(2) Heating Plant (Hydronic and steam heating systems, controls)
(3) Plumbers (Plumbing, gas-fired heating, process piping systems)
(4) Refrigeration (Refrigeration, chilled water, packaged cooling systems)

d. Schedule:
   i. Duplicate training sessions are to be provided for each training module, so that Owner's operating personnel can be split into two groups during training. Duplicate training sessions to be scheduled during different weeks. Length of training sessions will be determined by scope of training, and as coordinated with Owner after draft copy of training documents have been reviewed.

2.1 PRODUCTS

1. Not applicable

3.1 EXECUTION

1. Demonstration:
   a. Demonstration Program:
      i. Engineer to develop a demonstration program to verify the proper operation of all required systems. Submit program to Owner and Contractor at least two weeks prior to Demonstration.
      ii. Engineer to work with Contractor to generate methods to be used to verify sequences and modes of operation that cannot be verified directly.
      iii. Engineer to provide at least one copy of all submittals, contract drawings, specifications, and changes related to systems to be demonstrated. Documents to be made available during Demonstration.
      iv. Contractor to provide at least one copy of Operating and Maintenance Manuals to be used during demonstration, including specified sequences of operation for field-constructed systems, and operating sequences for all manufactured equipment.

   b. Demonstration Session:
      i. Verify that all systems are functional and ready to operate in all modes prior to demonstration.
      ii. Assemble all program materials required for demonstration.
      iii. Contractor to provide all equipment necessary for access to, and operation of, systems including tools, ladder, lighting, and diagnostic equipment.
      iv. Verify operation of individual components within systems.
      v. Verify controls of related components are coordinated.
      vi. Verify all operating sequences, operating modes, and safety controls.
      vii. Record all pressures, temperatures, and other relevant data available from installed devices.
      viii. Where digital control systems are available, set-up trend reports of relevant parameters which will confirm proper operation of systems installed, modified, or affected by changes made during this project. Provide copies of reports to Engineer and Owner for review. Review, analyze, and discuss results, and provide follow-up reports as required to confirm proper operation.

2. Training:
   a. Training Documentation:
      i. Contractor to submit draft copy of agenda and training documents to Owner for review at least two weeks prior to training date.
      ii. Provide a copy of the following items for each person that will be attending the

training sessions. Coordinate required number with the Owner.

(1) Training agenda.
(2) Summary of new systems and existing systems affected by this project.
(3) Summary of work performed under this project.
(4) Control system drawings and sequences of operation.
(5) List of important maintenance and trouble-shooting operations for all systems.

iii. Provide minimum of 2 copies of following items:

(1) Contract documents including all drawings, specifications, addendums, and change orders.

b. Training Sessions:

i. Assemble at location to be determined by the Owner.
ii. Distribute training documentation as indicated above.
iii. Provide classroom style training if required for orientation, discussion of new systems and existing systems affected by this project, and other issues appropriate for a classroom format.
iv. Visit site and review locations, and perform detailed review of operation and maintenance requirements for current systems.

END OF SECTION 179000

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
B. Section 07 0150.19 - Preparation for Re-Roofing: Removal of existing roofing, roof insulation, flashing, trim, and accessories.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.
B. Site Plan: Indicate:
   1. Areas for temporary construction and field offices.
C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
   1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
   2. Demolition firm qualifications.
D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 40 hours of documented experience in Asbestos regulation training for the project Superintendent.
   2. Minimum of 8 hours of documented experience in Asbestos regulation training for the workers removing roofing materials.

PART 3 EXECUTION

2.01 DEMOLITION

A. Selective demolition of the following items as indicated on drawings:
   1. Ceiling tile and grid
   2. Eye wash plumbing fixtures
   3. Casework / work bench
   4. Mechanical and Electrical as indicated.
B. Remove all Asbestos Containing Materials as identified in the Inspection Report..
   1. Provided by owner.
C. Remove other items indicated, for salvage, relocation, recycling, and reinstallation.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.

4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.
C. Protect existing structures and other elements to remain in place and not removed.

2.03 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
B. Protect existing utilities to remain from damage.
C. Do not disrupt public utilities without permit from authority having jurisdiction.
D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
E. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
B. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
C. Remove existing work as indicated and required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
   2. Remove items indicated on drawings.
D. Services including, but not limited to, HVAC, Plumbing, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Verify that abandoned services serve only abandoned facilities before removal.
   3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
E. Protect existing work to remain.
   1. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   2. Repair adjacent construction and finishes damaged during removal work.
   3. Patch to match new work.

2.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; do not burn or burry.
C. Leave site in clean condition, ready for subsequent work.
D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 4100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.
B. Rough opening framing for doors, windows, and roof openings.
C. Preservative treated wood materials.
D. Fire retardant treated wood materials.
E. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
B. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2024).
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.
E. PS 20 - American Softwood Lumber Standard; 2025.

1.03 SUBMITTALS

A. See Section 01 3000 Submittals, for submittal procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.05 WARRANTY

A. See Section 01 7400 Warranties and Bonds,for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
    1. Species: Douglas Fir-Larch, unless otherwise indicated.
    2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
    3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
    4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.
B. Moisture Content: S-dry or MC19.
C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
    1. Lumber: S4S, No. 2 or Standard Grade.
    2. Boards: Standard or No. 3.

2.03 ACCESSORIES

A. Metal and Finish of Fasteners:
   1. Preservative-Treated Wood:
      a. Nails, timber rivets, wood screws, and lag screws - general use: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
   2. Untreated Wood: Unfinished steel.
B. Sill Gasket on Top of Foundation Wall: 3/8 inch thick, closed-cell plastic foam.
   1. Width: 3-1/2 inches.
   2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

3.03 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

END OF SECTION 06 1000

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.
B. Countertops.
C. Hardware.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
D. BHMA A156.9 - Cabinet Hardware; 2020.
E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 0000 - General Requirements, for submittal procedures
B. See Section 01 3000 - Administrative Requirements for submittal procedures.
C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
D. Product Data: Provide data for hardware accessories.
E. Samples: Submit actual samples of architectural cabinet construction, minimum 8 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
    1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
B. Quality Certification:
    1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
    2. Provide designated labels on shop drawings as required by certification program.
    3. Provide designated labels on installed products as required by certification program.
    4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
    5. Replace, repair, or rework all work for which certification is refused.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Plastic Laminate Faced Cabinets: Custom grade. Match existing

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.
B. Provide sustainably harvested wood, certified or labeled; see Section 01 6000.

2.03 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
   1. Grade: 115; moisture resistance: MR10.
   2. Panel Thickness: 3/4 inch.

2.04 LAMINATE MATERIALS

A. Manufacturers:
   1. Arborite; ColorEdge: www.arborite.com/#sle.
   2. Formica Corporation; ____: www.formica.com/#sle.
   3. Wilsonart LLC; ____: www.wilsonart.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.
B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

2.05 COUNTERTOPS

2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: Match existing.
C. Fasteners: Size and type to suit application.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.

2.07 HARDWARE

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Hardware Types: Match existing types.
   2. Product Grade: As required by specified woodworking quality grade.
B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
C. Countertop Brackets: Fixed, concealed vertical leg, side-of-stud mounting.
   1. Materials: Steel L- and T-shapes.
      a. Finish: Manufacturer's standard, factory-applied, powder coat.
      b. Color: Black.
      c. Vertical Leg: 12 inches.

d. Support Member Depth: 1/2 inch.
e. Support Member Width: 2 inches
f. Support Member Length: 9 inches.

2. Products:
   a. A&M Hardware, Inc; Concealed Brackets: www.aandmhardware.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.

D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
   1. Match existing

E. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Manufacturers:
      a. Accuride International, Inc; Light-Duty Drawer Slides: www.accuride.com/#sle.
      b. Blum, Inc; MOVENTO: www.blum.com/#sle.
      c. Knape & Vogt Manufacturing Company; Light-Duty Drawer Slides: www.knapeandvogt.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

F. Soft-Close, Door and Drawer Adjustable Dampers:
   1. Manufacturers:
      a. Grass America Inc; ____: www.grassusa.com/#sle.
      b. Titus Cabinet Hardware; Slidix: www.titusplus.com/us/en/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

G. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
   1. Manufacturers:
      a. Blum, Inc; CLIP top BLUMOTION: www.blum.com/#sle.
      b. Hettich America, LP; _____: www.hettich.com/#sle.
      c. Titus Cabinet Hardware; S-Type Concealed Hinge: www.titusplus.com/us/en/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.08 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
B. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
C. Secure cabinets to floor using appropriate angles and anchorages.
D. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.02 ADJUSTING

A. Adjust installed work.
B. Adjust moving or operating parts to function smoothly and correctly.

3.03 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 4100

THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
B. Sound batt insulation at sound walls.
C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation in Wood Framed Walls: Batt insulation with no vapor retarder.
B. Insulation in Floor-Ceiling assembly: Batt insulation with no vapor retarder.
C. Insulation inside exterior wall cavity over foam in place insulation.
D. Insulation at window and door shim space.
E. Insulation in storefront framing systems.
F. Insulation in sound walls.

2.02 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
    1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
    2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
    3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
    4. Formaldehyde Content: Zero.
    5. Thickness: 3 1/2 inch with a thermal resistance of R-11.
        a. At exterior walls over foamed-in-place insulation.
    6. Thickness: 9 1/2 inch at floor ceiling assembly.
    7. Facing: Unfaced.
    8. Products:
        a. CertainTeed Corporation; _____: www.certainteed.com/#sle.
        b. Johns Manville; _____: www.jm.com/#sle.
        c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
    9. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Sheet Vapor Retarder: clear polyethylene film for above grade application, thick.
B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
E. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet retarder joints over face of member.
F. Tape seal tears or cuts in vapor retarder.
G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane; tape seal in place.

3.03 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 2100

FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.
B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

A. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
B. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

1.04 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
    1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
B. Installer Qualifications: Company specializing in performing the work of this section and:
    1. Trained by the manufacturer.
    2. With minimum 3 years documented experience installing work of this type.

1.05 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.01 FIRESTOPPING - GENERAL REQUIREMENTS

A. Firestopping: Any material meeting requirements.
B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
C. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

B. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

A. Gypsum Board Walls:
   1. Wall to Wall Joints:
      a. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
      b. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
   2. Top of Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
      a. 1 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
   3. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
      a. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Blank Openings:
   1. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
B. Penetrations By:
   1. Multiple Penetrations in Large Openings:
      a. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 1 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      c. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   2. Uninsulated Metallic Pipe, Conduit, and Tubing:
      a. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
      a. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
      b. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   4. Cable Trays with Electrical Cables:
      a. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
   5. Insulated Pipes:
      a. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
   6. HVAC Ducts, Insulated:
      a. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.05 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: See Drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.
C. Install backing materials to arrest liquid material leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. Install labeling required by code.

3.04 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 8400

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Acoustic insulation.
D. Cementitious backing board.
E. Gypsum wallboard.
F. Joint treatment and accessories.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 59 with the installation of sound isolation clips one layer gyp each side and sound attenuation batts calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
C. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire Rated Partitions: See Drawings.

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
B. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.
D. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
   1. Products:
      a. ClarkDietrich; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.
E. Preformed Top Track Firestop Seal:
   1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
F. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. CertainTeed Corporation; ____: www.certainteed.com/ceilings-and-walls/#sle.
      b. USG Corporation; Drywall Suspension System: www.usg.com/#sle.

c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. CertainTeed Corporation; ____: www.certainteed.com/#sle.
   2. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.
   3. USG Corporation; ____: www.usg.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
   3. Type:
      a. Type X
      b. Long edges, Tapered

C. Backing Board For Wet Areas:
   1. Application: Surfaces in wet areas including Behind all FRP at eye wash stations.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 1/2 inch.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:
      a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
      b. Liquid Nails, a brand of PPG Architectural Coatings: www.liquidnails.com/#sle.
      c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. L-Trim with Tear-Away Strip: Sized to fit 1/2-inch thick gypsum wallboard.

C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Joint Compound: Setting type, field-mixed.

D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

E. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.
B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Laterally brace entire suspension system.
C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
D. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
E. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
F. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Corner Beads: Install at external corners, using longest practical lengths.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TEXTURE FINISH

A. Texture Required: Level 4 with Smooth Finish. Review finish with owner. match existing

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.09 CLEANING

A. Clean _____.

3.10 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 09 2116

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.
B. Acoustical units.

1.02 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2024a.
E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate grid layout and related dimensioning.
C. Product Data: Provide data on suspension system components and acoustical units.
D. Samples: Submit two samples 4 by ____ inch in size illustrating material and finish of acoustical units.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels: M
    1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
    2. USG Corporation; ____: www.usg.com/#sle.
    3. Substitutions: See Section 01 6000 - Product Requirements.
B. Suspension Systems:
    1. Same as for acoustical units.

2.02 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Class A in accordance with ASTM E84.
B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D and complying with the following:
    1. Local authorities having jurisdiction.

2.03 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
B. Acoustical Panels: Painted mineral fiber, with the following characteristics:
    1. Classification: ASTM E1264 Type A.

2. Size: 24 by 24 inches.
3. Thickness: 3/4 inch.
4. Panel Edge: Square.
5. Tile Edge: Beveled.
   a. Joint: Kerfed and rabbeted.
6. Color: White.
7. Suspension System: Exposed grid.

2.04 SUSPENSION SYSTEMS

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold-down clips, stabilizer bars, clips, and splices as required.
B. Exposed Suspension System: Hot-dip galvanized steel grid with aluminum cap.
   1. Applications: Seismic.
   2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   3. Profile: Tee; 15/16 inch face width.
   4. Finish: Baked enamel.
   5. Color: White.

2.05 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
C. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
D. Perimeter Moldings: Same metal and finish as grid.
   1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
D. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.
E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
H. Do not eccentrically load system or induce rotation of runners.

3.02 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
C. Fit border trim neatly against abutting surfaces.
D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
E. Cutting Acoustical Units:
    1. Make field cut edges of same profile as factory edges.

3.03 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.04 CLEANING

A. Clean surfaces.

END OF SECTION 09 5100

GLASS FIBER REINFORCED PLASTIC PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.
B. Trim.

1.02 REFERENCE STANDARDS

A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.
B. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
C. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
E. ISO 846 - Plastics - Evaluation of the Action of Microorganisms; 2019.
F. ISO 2812-1 - Paints and Varnishes -- Determination of Resistance to Liquids -- Part 1: Immersion in Liquids Other than Water; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
    1. Marlite, Inc: www.marlite.com/#sle.
    2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
    1. Panel Size: 4 by 8 feet.
    2. Panel Thickness: 0.10 inch.
    3. Surface Design: Smooth.
    4. Color: White.
    5. Attachment Method: Mechanical fasteners concealed by trim, with sealant in joints.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
    1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
    2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    3. Sanitation and Cleanability: Comply with 9 CFR 416.2.

4. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.
5. Biological Resistance: Rating of 0, when tested in accordance with ISO 846.

B. Trim: Vinyl; color coordinating with panel.
C. Fasteners: Nylon rivets.
D. Adhesive: Type recommended by panel manufacturer.
E. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.
B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
C. Pre-drill fastener holes in panels, 1/8 inch greater in diameter than fastener, spaced as indicated by panel manufacturer.
D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
F. Install panels with manufacturer's recommended gap for panel field and corner joints.
G. Drive fasteners to provide snug fit, and do not over-tighten.
H. Place trim on panel before fastening edges, as required.
I. Fill channels in trim with sealant before attaching to panel.
J. Install trim with adhesive and screws or nails, as required.
K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
L. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION 09 7733

INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
    1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
    2. Mechanical and Electrical:
        a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
D. Do Not Paint or Finish the Following Items:
    1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
    2. Items indicated to receive other finishes.
    3. Items indicated to remain unfinished.
    4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
    5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
    6. Floors, unless specifically indicated.
    7. Glass.
    8. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 Submittals, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
    1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
    2. Manufacturer's installation instructions.
    3. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
    1. Where sheen is specified, submit samples in only that sheen.
    2. Allow 14 for approval process, after receipt of complete samples by Architect.
D. Manufacturer's Instructions: Indicate special surface preparation procedures.
E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data

sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer3.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
D. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
    1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
B. Paints:
    1. Base Manufacturer: Provide products by one of the following, or approved equal.
    2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
    1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
    2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
    3. Supply each paint material in quantity required to complete entire project's work from a single production run.
    4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
B. Volatile Organic Compound (VOC) Content:
    1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Owner from the manufacturer's full line.

E. Colors: To be selected from manufacturer's full range of available colors.

1. Selection to be made by Owner after award of contract.
2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including .

1. Two top coats and one coat primer.
2. Top Coat(s): Interior Latex; MPI #43, 44, 52, 53, 54, or 114.
   a. Products:
      1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel. (MPI #52)
      2) Substitutions: See Section 01 6000 - Product Requirements
3. Top Coat Sheen:
   a. Eggshell: MPI gloss level 3; use this sheen at all locations.
4. Primer: As recommended by top coat manufacturer for specific substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 9123

SOLID-PLASTIC LABORATORY CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Standard solid-plastic cabinets and cabinet hardware.
B. Countertops.

1.02 REFERENCE STANDARDS

A. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
B. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2020.
C. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
D. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials; 2024.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
F. BHMA A156.9 - Cabinet Hardware; 2020.
G. SEFA 2 - Installations; 2010.
H. SEFA 3 - Laboratory Work Surfaces; 2020.
I. SEFA 7 - Laboratory Fixtures; 2021.
J. SEFA 8P - Laboratory Grade Polypropylene Casework; 2014.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
C. Maintenance Data: Manufacturer's recommendations for care and cleaning.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Correct defective work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
    1. Discoloration, or lack of finish integrity.
    2. Heat-welds or any other structural failure.
    3. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solid-Plastic Laboratory Casework:
    1. LabAire Systems, a Division of Activar Plastic Products Group, Inc; _____: www.labairesystems.com/#sle.
    2. PolyGuard Scientific, a Division of Aeromat Plastics, Inc; Type _____: www.polyguardsci.com/#sle.

2.02 SOLID-PLASTIC LABORATORY CASEWORK

A. Casework: Solid-plastic, each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
   1. Style: Flush reveal overlay - square edge.
   2. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7 and SEFA 8P, provide components that safely support the following minimum loads, without deformation or damage:
      a. Base Units: 400 pounds per linear foot across the cabinet ends.
   3. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
   4. Edges and Seams: Smooth. Form counter tops, facing, shelves, and drain boards from continuous sheets of material.
   5. Welding: Hot-air, full-seam welding.
   6. Drawers and Doors: Fabricate drawer and door fronts of same materials as cases.
   7. Shelves: Adjustable and fixed shelves of same material as cases.
   8. Filler Panels: Of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
   9. Scribe Panels: Similar to filler panels, of matching construction and finish.

B. Countertop Panel-Type Supports: Materials similar to adjacent casework, 1-1/2 inch in width, with front-to-back and toe space dimensions matching base cabinet. Designed to be secured in a concealed fashion to countertop material. Include two leveling devices per support panel.

2.03 CABINET HARDWARE

A. Manufacturer's standard styles.
B. Comply with BHMA A156.9 requirements.
C. Swinging Doors:
   1. Hinges: Manufacturer's standard, non-metallic hinges and fasteners.
   2. Catches: Polyethylene coated magnets embedded in door and frame.
   3. Pulls: Polypropylene, recessed 4 inches wide.
D. Drawers:
   1. Pulls: Polypropylene wire pulls, ___ inches wide.

2.04 COUNTERTOPS

A. Countertops: Manufacturer's standard worksurfaces, compatible with casework, and complying with requirements of SEFA 3.

2.05 MATERIALS

A. Polypropylene: Sheets and shapes, ASTM D4101.
   1. Density: Results when tested in accordance with ASTM D792.
   2. Hardness, Shore D: Results when tested in accordance with ASTM D2240.
   3. Water Absorption: Results when tested in accordance with ASTM D570.
B. Phenolic Panels: Monolithic core of phenolic resin reinforced with cellulose fibers and manufactured under high pressure and at high temperatures, with melamine-impregnated decorative surface papers; NEMA LD 3 Compact Laminate, Grade CGS.
C. Sealant For Use in Casework Construction: Manufacturer's recommended type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only

where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure, with no distortion.
   1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
   1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
   2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
   3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
   4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.

G. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

H. Replace units that are damaged, including those that have damaged finishes.

3.02 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.03 CLEANING

A. Clean casework and other installed surfaces thoroughly.

3.04 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.

C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 12 3553.23

FIRE PROTECTION SYSTEMS

PART 1 GENERAL

1.01 SCOPE

A. Furnish and modify an automatic fire sprinkler system to protect all areas remodel areas of the existing MSU Molecular Bioscience Building as indicated herein and as shown on the drawings. The current system is connected to the existing mechanical chilled water system that is being taken out of service. The intent is to disconnect from existing fan coil units and any while maintaining the use of the existing chiller supply piping in its current capacity as wet system sprinkler supply. Both are connected system city water which has historically been of sufficient pressure to ensure full and sustained water discharge immediately from sprinkler heads when opened by fire at rated heat temperatures. Pere NFPA, the water supply shall conform to NFPA water supply requirements with considerations given to the reliability of the public water supply, taking into account probable minimum pressure conditions. Water model information provided by the Engineer for the water authority to be used for bidding of the fire sprinkler system is as follows: 105 PSI Static, 75 PSI Residual with 1,591 GPM flowing. Contractor shall obtain flow information from City of Bozeman Water Department for hydraulic calculations.

B. All portions of the systems shall be installed in accordance with the drawings, details, and specifications and as required by jurisdictional authorities and codes. The position is taken that the Owner is entitled to a project which meets or exceeds the minimum requirements of nationally recognized fire protection standards. All efforts and installations shall be directed toward this end. Where there is conflict between the contract drawings and/or specifications, and the requirements of the jurisdictional authorities or codes, the conflict shall be brought to the attention of the Engineer at least ten (10) days prior to bidding or be resolved at no cost to the Owner. If the contractor has not identified conflicts to the Engineer, he shall be responsible for complying with the most restrictive (expensive) methods.

C. The intent of these specifications is to describe the complete systems to be installed, including minor details of work or materials not specifically mentioned or shown on the drawings, but necessary for the successful operation and completion of the installation.

D. Work to be performed under this section shall include, but not be limited to the following:
   1. Wet pipe flow switch system.
      a. Pipe and fittings.
      b. Hangers and supports.
      c. Earthquake bracing.
      d. Valves.
      e. Alarms.
      f. Flow and Tamper Switches.
      g. Specialties.

E. Furnish and install an automatic fire protection system of type or types required in the following areas:
   1. Wet pipe flow switch system: All heated areas of the building including main level and upper level offices.
   2. Existing anti-freeze pipe system: All unheated areas of the building including combustible attic space. (No new work)

1.02 RELATED WORK

A. All work performed under this section of the specifications shall be subject to the requirements of both the General and Special Conditions.

1.03 REGULATORY AGENCIES

A. The term jurisdictional authority used in this section of the specification shall include, as applicable, but not be limited to the following:
   1. City of Bozeman Building Department.
   2. City of Bozeman Fire Department.
   3. Insurance Services Office or Owners Insuring Authority having jurisdiction.
   4. Owner.

B. The design and installation of all systems of fire protection shall conform to all requirements of applicable codes and publications herein defined:
   1. International Building Code (2021)
   2. NFPA #13 (2019)
   3. All State and local ordinances
   4. Underwriters' Laboratories
   5. American Society of Testing Materials
   6. American National Standards Institute
   7. Occupational Safety and Health Administration

1.04 SUBMITTALS

A. General
   1. The successful Contractor shall provide submittal data as required under other portions of this specification. Submittals shall conform to the instructions set forth in the General and Special Conditions of these specifications entitled Shop Drawings and Submittals.
   2. Work on the project shall not begin until submittals have been accepted by the Engineer.

B. Shop Drawings
   1. Submit shop drawings (floor plans - detailed working drawings), showing dimensions, ducts, lights, or other items affecting the fire protection systems shall be submitted to jurisdictional agencies for review and approval. All items identified in NFPA #13 for proper working drawings shall be complied with. The Engineer will reject all submittals not in compliance. Concurrently, shop drawings shall be sent to the Engineer for review. After approvals from jurisdictional agencies have been returned to the Contractor, they shall be submitted to the Engineer for final acceptance. These final acceptance sets shall have all agencies' stamps of review and acceptance.
   2. Shop drawings shall be prepared in AutoCAD or compatible software.
   3. Engineer's review will be for general location and compliance with design intent only. It will be the Contractor's responsibility to check all contract documents and coordinate his drawings for interferences with other trades.

C. Catalog/Product Information
   1. Full catalog information shall be submitted for approval for all materials intended for use on this project. Catalog information indicating more than one item shall be highlighted to clearly indicate the proposed equipment.

D. Hydraulic Calculations
   1. Hydraulic calculations shall be submitted for approval. Calculations shall be provided to substantiate the pipe sizes shown on shop drawings. Should the Engineer question the pipe size for any area, the Contractor shall provide additional calculations to the satisfaction of the engineer.

E. Installer's Qualifications
   1. All systems of fire protection shall be installed by a licensed (for the location of installation) Fire Protection Contractor, fully experienced in fire protection installation as required and specified herein.
   2. All installers shall be competent and shall hold an endorsement by the State of Montana. Prior to beginning work, current Contractor's and Installer's license and endorsements

shall be on file with the Department of Commerce Professional and Occupational Licensing Bureau (301 South Park, P.O. Box 200513, Helena, MT 596200513).

3. Fire Protection Contractors may be required to provide in writing specific information as to successfully completed projects and references to show cause as to why they should be considered acceptable to the engineer.

F. Close-Out
   1. Record Drawings required per paragraph 1.06 and Operation and Maintenance Manuals required per paragraph 1.07, shall be submitted for approval at the completion of the system installation.

1.05 JOB CONDITIONS

A. The Contractor shall investigate the structural, mechanical, electrical, and finished conditions affecting the piping, and shall arrange the equipment accordingly; furnishing required fittings, offsets and accessories. Route fire protection piping to avoid interference with duct work and drain piping. In the event it becomes necessary to make field changes in pipe locations due to building construction, the Contractor shall consult with the Engineer before making any changes. Any such changes required shall be made without added cost to the Owner.
B. The Contractor shall determine, and be responsible for, the proper locations and type of inserts for hangers, chases, sleeves, and other openings in the construction required for fire protection work, and shall obtain this information well in advance of the construction progress to avoid delay of the work.
C. The drawings indicate approximate locations of sprinkler heads and conceptual routing of piping. Contractor is responsible for final locations and routing. Contractor shall review all contract documents including architectural, structural, mechanical, electrical, etc. for actual contract conditions.
D. All fees and permits specifically required for fire protection work, not obtained by others as specified elsewhere shall be applied for and paid for by this Contractor.

1.06 RECORD DRAWINGS

A. One approved set of drawings shall be maintained on the job at all times.
B. One set of “As-Built” drawings shall be kept on the job at all times. “As-Built” drawings shall be kept current daily. “As-Built” drawings shall be available at all times to Engineer for review and use.
C. One reproducible set of “As-Built” drawings shall be provided to the Engineer upon completion of the work.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Three (3) sets of operating and maintenance instructions shall be provided the Owner upon completion. Manuals shall include, as a minimum, the following:
   1. “As-Built” Drawings
   2. Catalog cut sheets of all materials installed
   3. Equipment maintenance manuals
   4 Hydraulic Calculations
   5. Acceptance Test Certificate
   6. Certification of Owner Training
   7. Contractor Guarantee and Warranty
   8. “As-Built” AutoCAD drawing (.dwg) file or equal on CD
B. One (1) Copy of NFPA #25 (2017) shall be provided to the Owner
C. If Operation and Maintenance Manuals are not provided within 30 days of final testing, the Engineer may accomplish such work. Cost of Operation and Maintenance Manuals shall be $1,000.00. Cost of Operation and Maintenance Manuals will be withheld from the contractor’s final payment.

1.08 TRAINING

A. The Fire Protection Contractor shall instruct the Owner in the operation of the systems. Instruction shall continue until the Owner is fully satisfied that he understands the operation of his system.
B. Contractor shall obtain Owner's dated signature that all training has been accomplished and is acceptable to the Owner.

1.09 GUARANTEES AND WARRANTIES

A. The Fire Protection Contractor shall guarantee to the Owner in writing, all equipment and workmanship for a period of one (1) year after the fire protection system has been placed in continuous service and has been accepted by all authorities having jurisdiction.
B. The Fire Protection Contractor shall not be held responsible for improper or negligent maintenance by the Owner after operating and maintenance indoctrination has been given the Owner.

PART 2 PRODUCTS

2.01 FIRE SPRINKLER SYSTEM EQUIPMENT

A. Where contract documents indicate specific model number or manufacturer; Contractor may substitute identical equipment approved for fire protection use.

2.02 AUTOMATIC SPRINKLERS

A. Install sprinklers from reviewed shop drawings.
B. All sprinklers shall be of similar design, be from a single manufacturer and match the K-factor of existing sprinklers that are being replaced.
C. The operating temperature of sprinklers shall be as required by the specific location of installation as required by NFPA #13.
D. Sprinklers shall conform to the following schedule:
    1. Brass upright sprinklers shall be used in all janitorial, storage or other non-public spaces where piping is exposed.
    2. White concealed pendent sprinklers shall be used in all finished areas, offices, bathrooms, corridors, etc. Contractor shall coordinate final finishes with architect.
    3. Dry chrome plated sidewall sprinklers shall be used at exterior canopies.
    4. All sprinklers shall be quick-response type.
E. Manufacturers
    1. Tyco
    2. Victaulic
    3. Viking
    4. Reliable

2.03 PIPE AND FITTINGS

A. Interior piping for automatic sprinkler system shall conform to NFPA #13 and as follows.
B. Sprinkler piping with threaded fittings shall be Schedule 40 black steel pipe. Concealed piping which is properly protected per code and listing requirements may be CPVC plastic with solvent welded fittings
C. Fittings for threaded and coupled pipe shall consist of cast iron or ductile threaded fittings joined with Teflon tape thread sealing compound or pipe joint compound. Pressure rating of fittings shall be as required for application.
D. Sprinkler piping with grooved fittings for sizes 2½" and larger shall be Schedule 10 black steel pipe.

E. Fittings for grooved end pipe shall consist of Tyco Grinnell Series or equal couplings and fittings in accordance with NFPA #13. Fittings for grooved end piping shall have a factory painted finish.
F. Fittings for plain end pipe shall not be used.
G. Alternate piping systems approved by NFPA #13 may be allowed with prior approval of the Engineer.
H. All drain and fire department connection piping and fittings down-stream of valves shall be galvanized. Malleable iron fittings are acceptable. Galvanized piping shall be Schedule 40.
I. Pipe drops to pendent sprinklers in suspended acoustical tile ceilings shall be made with U.L. listed flexible pipe drops. Flexible pipe drops shall have a stainless steel braided exterior covering.

2.04 HANGERS AND SUPPORTS

A. Space pipe hangers in accord with the requirements of NFPA #13. Construct hangers, hanger rods, inserts and clamps as approved by the same.
B. Manufacturers:
   1. Tolco
   2. Afcon
   3. Erico
   4. Speedy Product (Super Screws)
   5. Anvil

2.05 EARTHQUAKE BRACING

A. Furnish and install all seismic bracing and branch line restraint as required by the International Building Code, NFPA #13 and the authority having jurisdiction.
B. Seismic bracing component attachments shall be listed where required by NFPA #13 and shall be from a single manufacturer.

2.06 VALVES

A. No new valves anticipated under this scope.

2.07 BACKFLOW PREVENTION DEVICES

A. Backflow preventor is existing and shall remain.

2.08 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connection is existing and shall remain.

2.09 SPECIALTIES

A. Fire Seals
   1. Where piping passes through walls, floors or other building construction which by code requires a fire rating, approved fire rated assemblies shall be used. Proposed protection shall be submitted for approval. Plans shall clearly indicate details and locations of required protection.
B. Escutcheon Plates
   1. Where exposed piping passes through finish work, chrome plated or other finish acceptable to the Engineer wall plates shall be installed. Split wall plates or escutcheons shall be installed to fit snugly around piping. All wall plates shall be metal.
   2. Solid galvanized wall plates shall be used at both sides of all exterior walls.
C. Valve Identification
   1. All valves within the building shall have permanently marked identification signs provided in accordance with NFPA #13 standards. Signs shall be manufactured and not hand written. Signs shall be hung with galvanized or chrome chain.
D. Spare Head Supply

1. Furnish and install a supply of extra sprinklers of each type and degree link installed in the project, complete with mountable box. Mount box on wall next to the sprinkler entry riser Provide wrenches for each type of sprinkler installed in box.

2.10 ELECTRICAL DEVICES

A. No new electrical devices are anticipated under this scope.

PART 3 EXECUTION

3.01 DESIGN CRITERIA

A. The entire sprinkler system is not shown on plans. Plans indicate general design concept only. The intent is for the contractor to provide a complete sprinkler systems as required. This Contractor shall be responsible for surveying the site, existing construction, and new construction, and prepare working drawings for the total system.
B. The fire protection system supplier shall design the piping to supply the system. Piping shall be laid out so as not to interfere with the installation of other piping, ductwork or light fixtures.
C. All piping shall be run concealed wherever possible. Where piping is run exposed, special notation on Contractor's drawings to that effect shall be evident and conspicuous on the drawings. Any piping determined to be a problem shall be relocated at no cost to the Owner.
D. System piping to be hydraulically calculated in accordance with NFPA #13 to the point of connection verified for flow characteristics.
E. The preparation of all shop drawings and hydraulic calculations shall be accomplished and signed by a NICET Level III or higher fire sprinkler design technician or stamped and signed by a Registered Professional Engineer, competent in fire protection.

3.02 INSTALLATION

A. Where details of installation are not given, the installation shall be made using manufacturer's recommended practices or at the direction of the Engineer.
B. Contractor shall complete the fire protection systems ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use. After system has been activated for continuous use, water charges will be paid by the Owner.
C. This Contractor shall remove from the building, all rubbish and unused materials due to or connected with this installation.
D. The surface of all piping shall be cleaned and left ready for painting.

3.03 TESTING

A. All testing shall be accomplished in accord with NFPA standards and requirements.
B. This Contractor shall call for inspection and complete Contractor’s Material and Test Certificates signed by the authority having jurisdiction.
C. The entire sprinkler system shall be hydrostatically tested at not less than 200 psig pressure for a period of not less than two (2) hours or 50 psi above static pressure in excess of 150 psi for two (2) hours with no pressure drop in the system.
D. All testing shall be witnessed by a representative of the Engineer or Owner.
E. Where jurisdictional authority's standards are more stringent than the above test, they shall prevail.
F. Furnish copies of Aboveground Test Certificate with close-out documentation.

END OF SECTION 21 1313

SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section shall apply to all sections of Division 22.

1.2 RELATED WORK

A. Section 01, GENERAL REQUIREMENTS.
B. Section 01, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01, CONSTRUCTION WASTE MANAGEMENT.
D. Section 03, CAST-IN-PLACE CONCRETE: Concrete and Grout.
H. Section 05, STEEL DECKING: Building Components for Attachment of Hangers.
I. Section 05, COMPOSITE METAL DECKING: Building Components for Attachment of Hangers.
J. Section 07, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
K. Section 07, FIRESTOPPING.
L. Section 07, JOINT SEALANTS.
M. Section 22 07 11, PLUMBING INSULATION.

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
G. Manufacturer's Literature and Data: Manufacturer’s literature shall be submitted under the pertinent section rather than under this section.

1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
2. Equipment and materials identification.
3. Fire stopping materials.
4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
5. Wall, floor, and ceiling plates.

H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.

I. Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 QUALITY ASSURANCE

A. Products Criteria:
1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.

3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the general contractor
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the American Welding Society.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the general contractor prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

D. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the GENERAL CONTRACTOR for resolution. Printed copies or electronic files of manufacturer’s installation instructions shall be provided to the GENERAL CONTRACTOR at least 10 working days prior to commencing installation of any item.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these

items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to GENERAL CONTRACTOR for resolution.

3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by OWNER.
4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
5. If an installation is unsatisfactory to the GENERAL CONTRACTOR, the Contractor shall correct the installation at no additional cost or additional time to the Owner.

E. Plumbing Systems: UPC, Uniform Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the UPC. For UPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word “should” shall be interpreted as “shall”. Reference to the “code official” or “owner” shall be interpreted to mean the GENERAL CONTRACTOR.

G. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Owner. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the GENERAL CONTRACTOR. Such replacement shall be at no additional cost or additional time to the Owner.

3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

A. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61. Solder or flux containing lead shall not be used with copper pipe.

C. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.

D. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.

E. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Owner.

C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, shall be the same make and model.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.4 SAFETY GUARDS

A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 8 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

B. All Equipment shall have moving parts protected from personal injury.

2.5 FIRESTOPPING

A. Section 07, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 22 07 11, PLUMBING INSULATION, for pipe insulation.

2.6 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the

GENERAL CONTRACTOR in all cases. See the above specifications for lateral force design requirements.

B. For Attachment to Concrete Construction:
   1. Concrete insert: Type 18, MSS SP-58.
   2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the GENERAL CONTRACTOR for each job condition.
   3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the GENERAL CONTRACTOR for each job condition.

C. For Attachment to Steel Construction: MSS SP-58.
   1. Welded attachment: Type 22.
   2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

D. Attachment to Metal Pan or Deck: As required for materials specified in Section 05, STEEL DECKING. Section 05, COMPOSITE METAL DECKING.//

E. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

F. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.
   1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
   2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.

G. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
   1. General Types (MSS SP-58):
      a. Standard clevis hanger: Type 1; provide locknut.
      b. Riser clamps: Type 8.
      c. Wall brackets: Types 31, 32 or 33.
      d. Roller supports: Type 41, 43, 44 and 46.

e. Saddle support: Type 36, 37 or 38.
f. Turnbuckle: Types 13 or 15.
g. U-bolt clamp: Type 24.
h. Copper Tube:
1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
2) For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp. //Spring Supports (Expansion and contraction of vertical piping):
1) Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator. //
j. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2. Plumbing Piping (Other Than General Types):
a. Horizontal piping: Type 1, 5, 7, 9, and 10.
b. Chrome plated piping: Chrome plated supports.
c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.

H. Pre-insulated Calcium Silicate Shields:
1. Provide 360 degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.

b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.

5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

K. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.12 PIPE PENETRATIONS

A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.

B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.

C. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of GENERAL CONTRACTOR.

E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.

G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.

H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.

I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

2.14 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control

devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

F. Cutting Holes:
   1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by GENERAL CONTRACTOR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to GENERAL CONTRACTOR for approval.
   2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
   3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by GENERAL CONTRACTOR where working area space is limited.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.

H. Protection and Cleaning:
   1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the GENERAL CONTRACTOR. Damaged or defective items in the opinion of the GENERAL CONTRACTOR, shall be replaced at no additional cost or time to the Owner.
   2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment.

J. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.

L. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

M. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.

N. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.

P. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.

Q. Inaccessible Equipment:

1. Where the Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or additional time to the Owner.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 shall apply.

C. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are not

allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

A. Openings in building structures shall be planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered and will be considered by Owner under specified restrictions of phasing and service requirements as well as structural integrity of the building.

C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Owner operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.

E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to GENERAL CONTRACTOR for evaluation prior to actual work.

3.4 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the GENERAL CONTRACTOR.

B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.

D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC) and these specifications.

E. Overhead Supports:

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

F. Floor Supports:
   1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
   2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
   3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.
   4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LUBRICATION

A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to GENERAL CONTRACTOR in unopened containers that are properly identified as to application.
C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
E. All lubrication points shall be extended to one side of the equipment.

3.6 PLUMBING SYSTEMS DEMOLITION

A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the GENERAL CONTRACTOR. Such access shall be provided without additional cost or time to the Owner. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
B. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Owner property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and

any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

D. All equipment including fixtures, valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Owner property and shall be removed and delivered to GENERAL CONTRACTOR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Owner property expeditiously and shall not be allowed to accumulate. Coordinate with the GENERAL CONTRACTOR and Infection Control.

3.7 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, the plant facilities, equipment and systems shall be thoroughly cleaned and painted.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
2. The following Material and Equipment shall NOT be painted:
    a. Motors, controllers, control switches, and safety switches.
    b. Control and interlock devices.
    c. Regulators.
    d. Pressure reducing valves.
    e. Control valves and thermostatic elements.
    f. Lubrication devices and grease fittings.
    g. Copper, brass, aluminum, stainless steel and bronze surfaces.
    h. Valve stems and rotating shafts.
    i. Pressure gages and thermometers.
    j. Glass.
    k. Name plates.
3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.

3.9 STARTUP AND TEMPORARY OPERATION

A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.10 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the GENERAL CONTRACTOR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

C. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to GENERAL CONTRACTOR for approval.

3.11 OPERATION AND MAINTENANCE MANUALS

A. All new and temporary equipment and all elements of each assembly shall be included.

B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.

C. Manufacturer’s installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

D. Lubrication instructions, type and quantity of lubricant shall be included.

E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.

F. Set points of all interlock devices shall be listed.

G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.

H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.

I. Emergency procedures for shutdown and startup of equipment and systems.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01, GENERAL REQUIREMENTS.

B. Section 01, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Ball Valves.

D. Test and Balance reports for balancing valves.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
4. Piping diagrams of thermostatic mixing valves to be installed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Valves shall be prepared for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.

B. Valves shall be prepared for storage as follows:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature.
C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Asbestos packing and gaskets are prohibited.
B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
C. Valves in insulated piping shall have 2 inch stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
D. Exposed Valves over 2-1/2 inches installed at an elevation over 12 feet shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:
   1. 2 inches and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 150 psig and a CWP rating of 600 psig. The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.

2.3 BALANCING VALVES

A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.

B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
C. Threads on valve and mating pipe shall be examined for form and cleanliness.
D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
D. Valves shall be installed in a position to allow full stem movement.

3.3 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.
B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

END OF SECTION

SECTION 22 07 11
PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for the following:
   1. Plumbing piping and equipment.

B. Definitions:
   1. ASJ: All Service Jacket, Kraft paper, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. All insulation systems installed within supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, interiors of air conditioned or heating ducts, and mechanical equipment rooms shall be noncombustible or shall be listed and labeled as having a flame spread indexes of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723. Note: ICC IMC, Section 602.2.1.
   4. Cold: Equipment or piping handling media at design temperature of 60 degrees F or below.
   5. Concealed: Piping above ceilings and in chases, interstitial space, and pipe spaces.
   6. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   7. FSK: Foil-scrim-Kraft facing.
   8. Hot: Plumbing equipment or piping handling media above 104 degrees F.
   9. Density: Pcf - pounds per cubic foot.
   10. Thermal conductance: Heat flow rate through materials.
      a. Flat surface: BTU per hour per square foot.
      b. Pipe or Cylinder: BTU per hour per linear foot for a given outside diameter.
   11. Thermal Conductivity (k): BTU - inch thickness, per hour, per square foot, per degree F temperature difference.
   12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders/vapor barriers shall have a maximum published permeance of .02 perms.
   13. HWR: Hot water recirculating.
   14. CW: Cold water.
   15. SW: Soft water.
   16. HW: Hot water.

17. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
D. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING: Hot and cold water piping.
E. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
B. American Society for Testing and Materials (ASTM):

C449-2007 (R2013) ..... Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C450-2008 (R2014) ..... Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
Adjunct to C450..... Compilation of Tables that Provide Recommended Dimensions for Prefab and Field Thermal Insulating Covers, etc.
C680-2014 ..... Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs
E84-2015a..... Standard Test Method for Surface Burning Characteristics of Building Materials
E2231-2015..... Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation to Assess Surface Burning Characteristics

C. International Code Council, (ICC):

IMC-2012 ..... International Mechanical Code

D. National Fire Protection Association (NFPA):

90A-2015..... Standard for the Installation of Air-Conditioning and Ventilating Systems

E. Underwriters Laboratories, Inc (UL):

723-2008 (R2013)..... Standard for Test for Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 07 11, PLUMBING INSULATION”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM Designation.
    a. Insulation materials: Specify each type used and state surface burning characteristics.
    b. Insulation facings and jackets: Each type used and state surface burning characteristics.
    c. Insulation accessory materials: Each type used.
    d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation shall follow the guidelines in accordance with ASTM C1710.
    e. Make reference to applicable specification paragraph numbers for coordination.
    f. All insulation fittings (exception flexible unicellular insulation) shall be fabricated in accordance with ASTM C450 and the referenced Adjunct to ASTM C450.
3. Each accessory material: Minimum 120 ml (4 ounce) liquid container or 4 ounce dry weight for adhesives cement.

1.4 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.11.2.6, parts of which are quoted as follows:

    4.3.3.1 Pipe and duct insulation and coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels and duct silencers used in duct systems shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with ASTM E84 and appropriate mounting practice, e.g. ASTM E2231.

    4.3.3.3 Coverings and linings for air ducts, pipes, plenums and panels including all pipe and duct insulation materials shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service. In no case shall the test temperature be below 250 degrees F.

2. Test methods: ASTM E84, UL 723, and ASTM E2231.

3. Specified k factors are at 75 degrees F mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.
4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

1.5 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version & inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing.

D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

1.6 STORAGE AND HANDLING OF MATERIAL

A. Store materials in clean and dry environment, pipe insulation jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

PART 2 - PRODUCTS

2.1 FIBER GLASS

A. ASTM C553 (Blanket, Flexible) Type I, Class B-5, Density nominal 2 pcf, k = 0.27 at 75 degrees F, for use at temperatures up to 400 degrees F.

B. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k =0.26 at 75 degrees F, for use at temperatures up to 446 degrees F with an all service vapor retarder jacket (ASJ) and with polyvinyl chloride (PVC) premolded fitting covering.

2.2 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

A. ASTM C534/C534M, k =0.27 at 75 degrees F, flame spread not over 25, smoke developed not over 50, for temperatures from minus 40 degrees F to 199 degrees F. Under high humidity exposures for condensation control an external vapor retarder/barrier jacket is required. Consult ASTM C1710.

2.3 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be ASJ or PVDC Vapor Retarder jacketing.

B. ASJ shall be white finish (kraft paper) bonded to 1 mil thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture is 50 units, suitable for painting without sizing. Jackets shall have minimum 1-1/2 inch lap on longitudinal joints and minimum 3 inch butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: FSK or PVDC type for concealed ductwork and equipment.

D. Except for flexible elastomeric cellular thermal insulation (not for high humidity exposures), field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.)in high humidity locations conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 30 inch-pounds for interior locations and 80 inch-pounds for exterior or exposed locations or where the insulation is subject to damage.

E. Except for cellular glass thermal insulation, when all longitudinal and circumferential joints are vapor sealed with a vapor barrier mastic or caulking, vapor barrier jackets may not be provided. For aesthetic and physical abuse applications, exterior jacketing is recommended. Otherwise field applied vapor barrier jackets shall be provided, in addition to the applicable specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity locations //conveying fluids below ambient temperature//. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 30 inch-pounds) for interior locations and 80 inch-pounds for exterior or exposed locations or where the insulation is subject to damage.

F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be PVC conforming to Fed Spec L-P-535E, composition A, Type II Grade GU, and Type III, minimum thickness 0.03 inches. Provide color matching vapor retarder pressure sensitive tape. Staples, tacks, or any other attachment that penetrates the PVC covering is not allowed on any form of a vapor barrier system in below ambient process temperature applications.

2.4 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	**Insert Blocks mm (inches)**
Up through 5	6 long
6	6 long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 300 degrees F)), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

2.5 ADHESIVE, MASTIC, CEMENT

A. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
B. Other: Insulation manufacturers' published recommendations.

2.6 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
B. Staples: Outward clinching galvanized steel. Staples are not allowed for below ambient vapor barrier applications.
C. Wire: 18 gage soft annealed galvanized or 14 gage copper clad steel or nickel copper alloy or stainless steel.
D. Bands: 1/2 inch nominal width, brass, galvanized steel, aluminum or stainless steel.
E. Tacks, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall NOT be used to attach/close the any type of vapor retarder jacketing. Thumb tacks

sometimes used on PVC jacketing and preformed fitting covers closures are not allowed for below ambient vapor barrier applications.

2.7 REINFORCEMENT AND FINISHES

A. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

B. PVC fitting cover: Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 50 to 250 degrees F. Below 50 degrees F and above 250 degrees F provide mitered pipe insulation of the same type as insulating straight pipe. Provide double layer insert. Provide vapor barrier pressure sensitive tape matching the color of the PVC jacket.

2.8 FIRESTOPPING MATERIAL

A. Other than pipe insulation, refer to Section 07, FIRESTOPPING.

2.9 FLAME AND SMOKE

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM and UL standards and specifications. See paragraph "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Except for specific exceptions or as noted, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

B. Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down and sealed at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A).

C. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 60 degrees F and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 6 inches.

D. Install vapor stops with operating temperature 60 degrees F and below at all insulation terminations on either side of valves, pumps, fittings, and equipment and particularly in straight lengths every approx. 15 to 20 feet of pipe insulation. The annular space between the pipe and pipe insulation of approx. 1 inch in length at every vapor stop shall be sealed with appropriate vapor barrier sealant.

E. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

F. Plumbing work not to be insulated unless otherwise noted:

1. Piping and valves of fire protection system.

2. Chromium plated brass piping.
3. Water piping in contact with earth.

G. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum wet or dry film thickness.

H. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane or polyisocyanurate spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

I. Firestop Pipe insulation:
   1. Provide firestopping insulation at fire and smoke barriers through penetrations. Firestopping insulation shall be UL listed as defined in Section 07, FIRESTOPPING.
   2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
      a. Pipe risers through floors
      b. Pipe chase walls and floors
      c. Smoke partitions
      d. Fire partitions
      e. Hourly rated walls

J. Freeze protection of above grade outdoor piping (over heat tracing tape): 3/4 inch thick insulation, for all pipe sizes 3 inches and smaller and 1 inch thick insulation for larger pipes. Provide metal jackets for all pipe insulations.

K. Provide vapor barrier systems as follows:
   1. All piping exposed to outdoor weather.
   2. All interior piping conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air.

L. Provide PVC jackets over insulation as follows:
   1. Piping exposed in building, within 6 feet of the floor, on piping that is not precluded in previous sections.
   2. A 2 inch jacket overlap is required at longitudinal and circumferential joints with the overlap at the bottom.

3.2 INSULATION INSTALLATION

A. Glass Fiber Insulation:
   1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
   2. Cold equipment: 2 inch thick insulation faced with ASJ.

B. Flexible Elastomeric Cellular Thermal Insulation:
   1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the

insulation manufacturer. External vapor barrier jacketing may be required for expected or anticipated high humidity exposures. See ASTM C1710.

2. Pipe and tubing insulation:
   a. Use proper size material. Do not stretch or strain insulation.
   b. To avoid undue compression of insulation, use supports as recommended by the elastomeric insulation manufacturer. Insulation shields are specified under Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
   c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Bio-based materials shall be utilized when possible.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.

3.3 PIPE INSULATION SCHEDULE

A. Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Inches			
Operating Temperature Range/Service	**Insulation Material**	**Less than 1**	**1 – 1¼**	**1½ - 3**	**4 and Greater**
100-140 degrees F (Domestic Hot Water Supply and Return)	Glass Fiber (Copper) Flexible Elastomeric Cellular (PEX)	1.5 1.0	1.5 1.0	2.0 1.0	2.0 1.0
Domestic Cold Water	Glass Fiber (Copper)	1.0	1.0	1.0	1.0
Last 5’-0” of Vent Piping Prior to Exiting Building	Glass Fiber	2.0	2.0	2.0	2.0
PVC Storm Drain Piping and drain bowls	Glass Fiber	1.0	1.0	1.0	1.0

END OF SECTION

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Division 01, GENERAL REQUIREMENTS.

B. Division 01, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Division 07, FIRESTOPPING.

D. Division 07, JOINT SEALANTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

J. Section 22 07 11, PLUMBING INSULATION.

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Division 01, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. All items listed in Part 2 - Products.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.4 QUALITY ASSURANCE

A. A certificate shall be submitted prior to welding of steel piping showing the Welder’s certification. The certificate shall be current and no more than one year old. Welder’s qualifications shall be in accordance with ASME BPVC Section IX.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.

C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments; substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

2.2 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

A. From inside face of exterior wall to a distance of approximately 5 feet inside of building and underground inside building, material to be the same for the size specified outside the building.

2.3 ABOVE GROUND (INTERIOR) WATER PIPING

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. Water mains throughout the building.

B. Fittings for Copper Tube (2 ½" and larger):

1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
2. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.

C. Pipe: PEX Distribution System, ASTM F 877, SDR 9 tubing. (2" and smaller).

1.) Fittings for PEX Tube: ASTM F 1807, metal insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

2.) Provide colored piping. (blue = cold water, red = hot water)

D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.

E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.

2.4 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the owner or specified in other sections.
   1. Pipe: ASTM B43, standard weight.
   2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
   3. Nipples: ASTM B687, Chromium-plated.
   4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required.

2.5 TRAP PRIMER WATER PIPING

A. Pipe: Copper tube, ASTM B88, type K, hard drawn.

B. Fittings: Bronze castings conforming to ASME B16.18 Solder joints.

C. Solder: ASTM B32 alloy type Sb5. Provide non-corrosive flux.

2.6 DIELECTRIC FITTINGS

A. Provide dielectric couplings or unions between pipe of dissimilar metals.

2.7 STERILIZATION CHEMICALS

A. Hypochlorite: ASTM E1120.

B. Liquid Chlorine: ASTM E1229.

2.8 WATER HAMMER ARRESTER

A. Closed copper tube chamber with permanently sealed 60 psig air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:
   1. All solenoid valves.
   2. All groups of two or more flush valves.
   3. All quick opening or closing valves.
   4. All medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:
   1. All branch piping must connect after the existing water meter. No connections are permitted to connect on the water main running along the west wall of the addition. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the owner or specified in other sections.

2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
3. All pipe runs shall be laid out to avoid interference with other work/trades.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
    a. All piping shall be supported per the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
    b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
    c. Floor, Wall and Ceiling Plates, Supports, Hangers:
        1) Solid or split un-plated cast iron.
        2) All plates shall be provided with set screws.
        3) Pipe Hangers: Height adjustable clevis type.
        4) Adjustable Floor Rests and Base Flanges: Steel.
        5) Concrete Inserts: "Universal" or continuous slotted type.
        6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
        7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
        8) Rollers: Cast iron.
        9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
        10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.
        11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 20 feet for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
        12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint.

Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.

6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
   a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Division 07, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the firestopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Division 07, JOINT SEALANTS.

B. Domestic Water piping shall conform to the following:
   1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
   2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections. Submit testing plan to COR 10 working days prior to test date.
B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psig gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.
C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 200 psig gage during inspection and prove tight.
D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.
E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.

B. Use liquid chlorine or hypochlorite for sterilization.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct owner in operation and maintenance of the system.

END OF SECTION

SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Division 01, GENERAL REQUIREMENTS.

B. Division 01, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Division 07, FIRESTOPPING: Penetrations in rated enclosures.

D. Division 07, JOINT SEALANTS: Sealant products.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

F. Section 22 07 11, PLUMBING INSULATION.

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Division 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Piping.
2. Floor Drains.
3. Cleanouts.
4. Trap Seal Protection.
5. Penetration Sleeves.
6. Pipe Fittings.
7. Traps.
8. Exposed Piping and Fittings.

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 AS-BUILT DOCUMENTATION

A. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

B. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

A. Cast iron waste, drain, and vent pipe and fittings.

1. Cast iron waste, and drain, and fittings shall be used for the following applications:
   a. Vertical waste and soil stacks serving more than two floors.
2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.
5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.

B. Polyvinyl Chloride (PVC)

1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is below 60 degrees C (140 degrees F).
2. PVC piping and fittings shall be used for the following applications:
   a. All underground and aboveground waste and vent piping, except cast iron waste risers.
   b. Vertical vent piping.
   c. All exposed vent through roof piping to be painted black.
3. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.
4. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.2 EXPOSED WASTE PIPING

A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, and equipment.
   1. The Pipe shall meet ASTM B43, regular weight.
   2. The Fittings shall conform to ASME B16.15.
   3. Nipples shall conform to ASTM B687, Chromium-plated.
   4. Unions shall be brass or bronze with chrome finish. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.

B. In unfinished Rooms such as mechanical Rooms, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph “Sanitary Waste, Drain, and Vent Piping” can be used.

2.3 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
   1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
   2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.
   3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 125 psig at a minimum temperature of 180 degrees F. The end connection shall be solder joint copper alloy and threaded ferrous.

2.4 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 4 inches; and not less than 4 inches for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 24 inches shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 2 inches. When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with

square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 6 by 6 inches shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.5 FLOOR DRAINS

A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 16-ounce soft copper 2.5 to 4 lbs, flashing membrane, 24 inches square or another approved waterproof membrane shall be provided.

2.6 TRAPS

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.7 PENETRATION SLEEVES

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting

with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 2 inches above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the Uniform Plumbing Code (UPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the owner or specified in other sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings where possible.

F. The piping shall be installed to permit valve servicing or operation.

G. The piping shall be installed free of sags and bends.

H. Seismic restraint shall be installed where required by code.

I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer’s written instruction for use of lubricants, cements, and other installation requirements.

K. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

3.2 JOINT CONSTRUCTION

A. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

A. All piping shall be supported according to the Uniform Plumbing Code (UPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

B. Horizontal piping and tubing shall be supported within 12 inches of each fitting or coupling.

C. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 15 feet.

D. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable floor rests and base flanges shall be steel.
5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser clamps shall be malleable iron or steel.
7. Rollers shall be cast iron.
8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.

H. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

I. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Division 07, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Division 07, JOINT SEALANTS.

J. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.5 TESTS

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 10 foot head of water. In testing successive sections, test at least upper 10 feet of next preceding section so that each joint or pipe except upper most 10 feet of system has been submitted to a test of at least a 10 foot head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. For an air test, an air pressure of 5 psig gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
4. Final Tests: Either one of the following tests may be used.
    a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1 inch of water with a smoke machine. Chemical smoke is prohibited.
    b. Peppermint Test: Introduce 2 ounces of peppermint into each line or stack.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 07 92 00, JOINT SEALANTS: Sealing between fixtures and other finish surfaces.

F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.4 SUBMITTALS

A. Submittals, including number of required copies, will be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section will be marked “SUBMITTED UNDER SECTION 22 40 00, PLUMBING FIXTURES”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, connections, and capacity.

D. Operating Instructions: Comply with requirements in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA’s Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions will be // in electronic version on compact disc or DVD // inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation will be included in the operation and maintenance

manual. The operations and maintenance manual will include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks will be included. A List of recommended spare parts (manufacturer, model number, and quantity) will be furnished. Information explaining any special knowledge or tools the owner will be required to employ will be inserted into the As-Built documentation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead is prohibited in any potable water system intended for human consumption and will be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking will meet the requirements of NSF 61.

B. Plastic pipe, fittings, and solvent cement will meet NSF 14 and will be NSF listed for the service intended.

2.2 STAINLESS STEEL

A. Corrosion-resistant Steel (CRS):

1. Plate, Sheet and Strip: CRS flat products will conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
2. Finish: Exposed surfaces will have standard polish (ground and polished) equal to NAAMM finish Number 4.

B. Die-cast zinc alloy products are prohibited.

2.3 STOPS

A. Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in solid-surface, wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.

B. Furnish keys for lock shield stops to the owner.

C. Supply from stops not integral with faucet will be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.

D. Supply pipe from wall to valve stop will be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.

E. Mental Health Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.4 ESCUTCHEONS

A. Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

2.5 LAMINAR FLOW CONTROL DEVICE

A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device will provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device will also have a flow control restrictor and have vandal resistant housing. **Aerators are prohibited.**

2.14 EMERGENCY FIXTURES

A. Emergency Shower:
   1. Shower Head: Polished chrome plated, 8 inches in diameter.
   2. Installation: Head will be 84 inches above floor.
   3. Valves: Stay-open ball type, chrome plated, operated by a 24 inches stainless steel pull-rod with triangle handle. Pull-down opens valve push-up closes valve. Provide with thermostatic mixing valve to provide 20 gpm of tepid water from 85 to 95 degrees F.
   4. Provide with signage to easily locate fixture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixture Setting: Opening between fixture and floor and wall finish will be sealed as specified under Section 07 92 00, JOINT SEALANTS. Bio-based materials will be utilized when possible.

B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms will be hexagonal, polished chrome plated brass with rounded tops.

C. Toggle Bolts: For hollow masonry units, finished or unfinished.

E. Power Set Fasteners: May be used for concrete walls, will be 1/4 inch threaded studs, and will extend at least 1 1/4 inches into wall.

G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.

3.2 CLEANING

A. At completion of all work, fixtures, exposed materials and equipment will be thoroughly cleaned.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct owner’s Personnel in operation and maintenance of the system.

- - - E N D - - -

SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. Definitions:

1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

A. Section 00, GENERAL CONDITIONS

B. Section 01, GENERAL REQUIREMENTS

C. Section 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES

D. Section 07, FIRESTOPPING

E. Section 07, JOINT SEALANTS

F. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT

G. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC

1.3 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC

B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Equipment Vibration Tolerance:

1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However,

digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.

2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent then those specified. Refer any conflicts to the Project Engineer.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment Service Organizations:
   1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.

F. Execution (Installation, Construction) Quality:
   1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Project Engineer for resolution. Provide written hard copies or computer files of manufacturer’s installation instructions to the Project Engineer at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
   2. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

1.4 SUBMITTALS

A. Submit in accordance with Section 01, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.

B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.

C. Contractor shall coordinate all items that differ from original contract documents. This is includes electrical requirements, equipment weights, equipment physical dimensions, etc.

D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.

G. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
   1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Project Engineer.
   2. Submit electric motor data and variable speed drive data with the driven equipment.
   3. Equipment and materials identification.
   4. Fire-stopping materials.
   5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
   6. Wall, floor, and ceiling plates.

J. HVAC Maintenance Data and Operating Instructions:
   1. Maintenance and operating manuals in accordance with Section 01, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
   2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:
   1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Project Engineer. Such repair or replacement shall be at no additional cost to the Owner.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 JOB CONDITIONS – work in existing Building

A. Building Operation: Owner employees will be continuously operating and managing all facilities, including temporary facilities, that serve the facility.
B. Maintenance of Service: Schedule all work to permit continuous service as required by the facility.
C. Phasing of Work: Comply with all requirements shown on drawings or specified.
D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 68 degrees F minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by OWNER.
F. Acceptance of Work for Owner Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Owner, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Owner will process necessary acceptance and the equipment will then be under the control and operation of Owner personnel.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.
B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 BELT DRIVES

A. Type: ANSI/RMA standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.

B. Dimensions, rating and selection standards: ANSI/RMA IP-20 and IP-21.

C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.

D. Maximum Speed: 5000 feet per minute.

E. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take-up.

F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.

G. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

H. Sheaves and Pulleys:
1. Material: Pressed steel, or close grained cast iron.
2. Bore: Fixed or bushing type for securing to shaft with keys.
3. Balanced: Statically and dynamically.
4. Groove spacing for driving and driven pulleys shall be the same.

I. Drive Types, Based on ARI 435:
1. Provide adjustable-pitch //or fixed-pitch// drive as follows:
   a. Fan speeds up to 1800 RPM: 10 horsepower and smaller.
   b. Fan speeds over 1800 RPM: 3 horsepower and smaller.

2. Provide fixed-pitch drives for drives larger than those listed above.
3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

2.4 DRIVE GUARDS

A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.

B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4-inch bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. one-inch diameter hole shall be provided at each shaft centerline to permit speed measurement.

D. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

E. Access for Speed Measurement: One inch diameter hole at each shaft center.

2.5 LIFTING ATTACHMENTS

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 ELECTRIC MOTORS

A. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.7 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black plastic with white letters permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

C. Control Items: Label all temperature sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

D. Valve Tags and Lists:

1. HVAC: Provide for all valves other than for equipment in Section 23 82 00, CONVECTION HEATING.
2. Valve tags: Engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Typed or printed plastic coated card(s), sized 8-1/2 inches by 11 inches showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

2.8 FIRESTOPPING

Section 07, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 & 22, HVAC & PLUMBING INSULATION, for firestop pipe and duct insulation.

2.9 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

B. Supports for Roof Mounted Items:
   1. Equipment: Equipment rails shall be galvanized steel, minimum 18 gauge, with integral baseplate, continuous welded corner seams, factory installed 2 by 4 treated wood nailer, 18 gauge galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 11 inches. For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
   2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.

C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69.

D. Attachment to Concrete Building Construction:
   1. Concrete insert: MSS SP-58, Type 18.
   2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than four inches thick when approved by the Project Engineer for each job condition.
   3. Power-driven fasteners: Permitted in existing concrete or masonry not less than four inches thick when approved by the Project Engineer for each job condition.

E. Attachment to Steel Building Construction:
   1. Welded attachment: MSS SP-58, Type 22.
   2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8-inch outside diameter.

F. Attachment to Metal Pan or Deck: As required for materials specified in Section 05, STEEL DECKING or Section 05, COMPOSITE METAL DECKING.

G. Attachment to existing structure: Support from existing floor/roof frame.

H. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

J. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches**,** No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.

1. Allowable hanger load: Manufacturers rating less 200 pounds.
2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

K. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 & 22 HVAC & PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.

L. Pre-insulated Calcium Silicate Shields:

1. Provide 360 degree water resistant high density 140 psi compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
    a. Shields for supporting hot water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
    b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields may have one or more of the following features: structural inserts 600 psi compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

2.10 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:
   1. For sleeves: Extend sleeve one inch above finished floor and provide sealant for watertight joint.
   2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
   3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Project Engineer.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

H. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

K. Sealant and Adhesives: Shall be as specified in Section 07, JOINT SEALANTS.

2.11 DUCT PENETRATIONS

A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 18 inches high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.

B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07, FIRESTOPPING.

2.12 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025-inch for up to 3-inch pipe, 0.035-inch for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.13 ASBESTOS

Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Project Engineer where working area space is limited.
2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Project Engineer. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Project Engineer for approval.
3. Do not penetrate membrane waterproofing.

F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

H. Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

I. Protection and Cleaning:
   1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Project Engineer. Damaged or defective items in the opinion of the Project Engineer, shall be replaced.
   2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

J. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum, specified in Section 03, CAST-IN-PLACE CONCRETE.

K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

L. Install steam piping expansion joints as per manufacturer’s recommendations.

M. Work in Existing Building:
   1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
   2. As specified in Section 01, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
   3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Project Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Project Engineer for determination of proper design for openings through structural sections and

opening layouts approval, prior to cutting or drilling into structure. After Project Engineer's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

N. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 6 ft. above the equipment of to ceiling structure, whichever is lower (NFPA 70).

P. Inaccessible Equipment:
   1. Where the Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
   2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Owner under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Owner operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Owner will check structure adequacy and advise Contractor of recommended restrictions.

E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to Project Engineer for evaluation prior to actual work.

G. Restore building to original condition upon completion of rigging work.

3.3 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and

then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Project Engineer.

B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:
   1. Up to 6-inch pipe, 30 feet long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
   2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports:
   1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
   2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
   3. Tubing and capillary systems shall be supported in channel troughs.

G. Floor Supports:
   1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
   2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 2 inch excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 6 inches on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
   3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

3.4 IDENTIFICATION SIGNS

A. Provide laminated plastic signs, with engraved lettering not less than 3/16-inch high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

3.5 MOTOR AND DRIVE ALIGNMENT

A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.6 LUBRICATION

A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.

B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one quart of oil and one pound of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Owner in unopened containers that are properly identified as to application.

C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.

D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.7 STARTUP AND TEMPORARY OPERATION

Startup equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation

3.8 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Section 01, GENERAL REQUIREMENTS and submit the test reports and records to the Project Engineer.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests

for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.9 INSTRUCTIONS TO OWNER PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01, GENERAL REQUIREMENTS.

E N D OF SECTION

SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation and connection of motors for HVAC and steam generation equipment.

1.2 RELATED WORK:

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.
B. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT .

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.
B. Shop Drawings:
    a. Provide documentation to demonstrate compliance with drawings and specifications.
    b. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
C. Manuals:
    a. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.
D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:
    a. Certification that the motors have been applied, installed, adjusted, lubricated, and tested according to manufacturer published recommendations.

1.4 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. National Electrical Manufacturers Association (NEMA):
MG 1-2006 Rev. 1 2009 .....Motors and Generators
MG 2–2001 Rev. 1 2007.....Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
C. National Fire Protection Association (NFPA):
70-2008 .....National Electrical Code (NEC)

D. Institute of Electrical and Electronics Engineers (IEEE):
112-04 ..... Standard Test Procedure for Polyphase Induction Motors and Generators

E. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
90.1-2007 ..... Energy Standard for Buildings Except Low-Rise Residential Buildings

PART 2 - PRODUCTS

2.1 MOTORS:

A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.

C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.

D. Voltage ratings shall be as follows:
    a. Single phase:
        i. Motors connected to 120-volt systems: 115 volts.
    b. Three phase:
        i. Motors connected to 208-volt systems: 200 volts.
        ii. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 208-230/460 volts, dual connection.

E. Number of phases shall be as follows:
    a. Motors, less than 373 W (1/2 HP): Single phase.
    b. Motors, 373 W (1/2 HP) and larger: 3 phase.
    c. Exceptions:
        i. Hermetically sealed motors.
        ii. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

F. Motors shall be designed for operating the connected loads continuously in a 40°C (104°F) environment, where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation. If the motors exceed 40°C (104°F), the motors shall be rated for the actual ambient temperatures.

G. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

H. Motor Enclosures:
   a. Shall be the NEMA types as specified and/or shown on the drawings.
   b. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.
   c. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

I. Special Requirements:
   a. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
   b. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
   c. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
      i. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
      ii. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
   d. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
   e. Motors utilized with variable frequency drives shall be rated “inverter-duty” per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

J. Additional requirements for specific motors, as indicated in the other sections listed in Article 1.2, shall also apply.

K. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts (1 HP) or more shall meet the minimum full-load efficiencies as indicated in the following table. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section. Motors not specified as “premium efficiency” shall comply with the Energy Policy Act of 2005 (EPACT).

Minimum Premium Efficiencies Open Drip-Proof				Minimum Premium Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

L. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

PART 3 - EXECUTION

3.1 INSTALLATION:

Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.2 FIELD TESTS

A. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before start-up. All shall test free from grounds.

B. Perform Load test in accordance with ANSI/IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.

C. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

D. All test data shall be complied into a report form for each motor and provided to the contracting officer or their representative.

3.3 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct GSA personnel in operation and maintenance of units.

- - - E N D - - -

SECTION 23 05 41
NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Noise criteria, seismic restraints for equipment, vibration tolerance and vibration isolation for HVAC and plumbing work.

1.2 RELATED WORK

A. Section 01, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.

B. Section 23 31 00, HVAC DUCTS and CASINGS.

1.3 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE in specification Section 23, COMMON WORK RESULTS FOR HVAC .

B. Noise Criteria:

1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed following NC levels:

TYPE OF ROOM	NC LEVEL
Bathrooms and Toilet Rooms	40
Corridors	40
Lobbies, Waiting Areas	30
Labs, Offices	25

2. For equipment, which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.
3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

C. Seismic Restraint Requirements:

1. Equipment:

a. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment shall be properly supported to resist a horizontal force of 50 percent of the weight of the equipment furnished.
b. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a horizontal force of 100 percent of the weight of the equipment furnished.

2. Piping: Refer to specification Section 23, COMMON WORK RESULTS FOR HVAC .
3. Ductwork: Refer to specification Section 23 31 00, HVAC DUCTS AND CASINGS.

D. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 0.20 inch per second RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Manufacturer's Literature and Data:
1. Vibration isolators:
a. Floor mountings
b. Hangers
c. Snubbers
d. Thrust restraints
2. Bases.
3. Seismic restraint provisions and bolting.
4. Acoustical enclosures.
C. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.
D. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, and manufacturer's certification that all specified equipment will withstand seismic Lateral Force.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.

B. Elastometric Isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.

C. Exposure to weather: Isolator housings to be either hot dipped galvanized or powder coated to ASTM B117 salt spray testing standards. Springs to be powder coated or electro galvanized. All hardware to be electro galvanized. In addition provide limit stops to resist wind velocity. Velocity pressure established by wind shall be calculated in accordance with section 1609 of the International Building Code. A minimum wind velocity of 75 mph shall be employed.

D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

E. Color code isolators by type and size for easy identification of capacity.

2.2 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENTS

A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material.

B. Floor mounted equipment, with vibration Isolators: Type SS. Where Type N isolators are used provide channel frame base horizontal restraints bolted to the floor, or other support, on all sides of the equipment Size and material required for the base shall be as recommended by the isolator manufacturer.

C. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment.

2.3 VIBRATION ISOLATORS

A. Floor Mountings:

1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
2. Spring Isolators (Type S): Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to--operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.
3. Captive Spring Mount for Seismic Restraint (Type SS):
    a. Design mounts to resiliently resist seismic forces in all directions. Snubbing shall take place in all modes with adjustment to limit upward, downward, and horizontal travel to a maximum of 1/4-inch before contacting snubbers. Mountings shall have a minimum rating of one G coefficient of gravity as calculated and certified by a registered structural engineer.
    b. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the

rated deflection. Mountings shall have ports for spring inspection. Provide an all directional neoprene cushion collar around the equipment bolt.

4. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting.
5. Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be natural rubber or neoprene waffle, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene**.** Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 50 pounds per square inch.
6. Seismic Pad (Type DS): Pads shall be natural rubber / neoprene waffle with steel top plate and drilled for an anchor bolt. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 50 pounds per square inch.

B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
   1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
   2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.
   3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.
   4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
   5. Hanger supports for piping 2 inches and larger shall have a pointer and scale deflection indicator.
   6. Hangers used in seismic applications shall be provided with a neoprene and steel rebound washer installed ¼’ clear of bottom of hanger housing in operation to prevent spring from excessive upward travel

C. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 1/4 inch. Air gap between hard and resilient material shall be not less than 1/8 inch nor more than 1/4 inch. Restraints shall be capable of withstanding design load without permanent deformation.

D. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 1/4 inch when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolation:
   1. No metal-to-metal contact will be permitted between fixed and floating parts.
   2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports with a deflection equal to that used on the corresponding equipment.
   3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
   4. Provide heat shields where elastomers are subject to temperatures over l00 degrees F.
   5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
   6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

B. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4inch movement during start and stop.
D. Adjust active height of spring isolators.
E. Adjust snubbers according to manufacturer's recommendations.
F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
G. Torque anchor bolts according to equipment manufacturer's recommendations to resist seismic forces.

END OF SECTION

SELECTION GUIDE FOR VIBRATION ISOLATORS

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
CENTRIFUGAL FANS															
UP TO 50 HP:															
UP TO 200 RPM	B	N	0.3	B	S	2.5	B	S	2.5	B	S	3.5	B	S	3.5
201 - 300 RPM	B	N	0.3	B	S	2.0	B	S	2.5	B	S	2.5	B	S	3.5
301 - 500 RPM	B	N	0.3	B	S	2.0	B	S	2.0	B	S	2.5	B	S	3.5
501 RPM & OVER	B	N	0.3	B	S	2.0	B	S	2.0	B	S	2.0	B	S	2.5
AIR HANDLING UNIT PACKAGES															
FLOOR MOUNTED:															
UP THRU 5 HP	---	D	---	---	S	1.0	---	S	1.0	---	S	1.0	---	S	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	D	---	R	S, THR	1.5	R	S, THR	2.5	R	S, THR	2.5	R	S, THR	2.5
501 RPM & OVER	---	D	---	---	S, THR	0.8	---	S, THR	0.8	R	S, THR	1.5	R	S, THR	2.0

NOTES:

1. Edit the Table above to suit where isolator, other than those shown, are used, such as for seismic restraints and position limit stops.
2. For suspended floors lighter than 100 mm (4 inch) thick concrete, select deflection requirements from next higher span.
3. For separate chiller building on grade, pump isolators may be omitted.
4. Direct bolt fire pumps to concrete base. Provide pads (D) for domestic water booster pump package.
5. For projects in seismic areas, use only SS & DS type isolators and snubbers.
6. For floor mounted in-line centrifugal blowers (ARR 1): use "B" type in lieu of "R" type base.
7. Suspended: Use "H" isolators of same deflection as floor mounted.

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment labels.

B. Pipe labels.

C. Valve tags.

1.2 REFERENCES

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

1.3 SUBMITTALS

A. Submit under provisions of Section 01 – Shop Drawings, Product Data, and Samples.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for HVAC equipment, piping, valve and duct identification.
1. Equipment Label Schedule: Provide a schedule of all equipment to be labeled with the proposed content for each label.
2. Pipe Label Schedule: Provide a schedule of each piping system indicating a proposed nomenclature and location of all pipe markers.
3. Valve Tag Schedule: Provide a proposed valve numbering scheme and schedule for each piping system. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, normal-operating position (open, closed, or modulating), and variations for identification. Mark valves intended for emergency shut-off and similar special uses.

D. Closeout Submittals: Record actual as built locations of valve tags and update schedules accordingly.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience

B. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience.

C. ASME Standards: Comply with ASME A13.1 for color scheme, lettering size, length of color field, and viewing angles of identification devices.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging with labels clearly identifying product name and manufacturer until ready for installation.

B. Storage: Store materials in clean, dry area indoors until ready for installation.

C. Handling: Protect materials and finish from damage during handling and installation.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation of identification system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.7 SEQUENCING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment

1.8 PROJECT CONDITIONS

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

PART 2 PRODUCTS

2.1 MECHANICAL IDENTIFICATION GENERAL

A. General: Provide manufacturer's standard products of categories and types required for each application specified. For each identification type, provide all products from same manufacturer with same text, style, color, shape, and other identification features.
1. Provide nameplates with the unit number on all mechanical equipment.
2. Provide pipe identification labels including direction-of-flow arrows and with service indicated. All labels shall have background colors matched with specific service designation.
3. Provide valve tag numbers on HVAC piping valves.
4. Provide duct identification labels including direction-of-flow arrows and with service indicated. All labels shall have background colors matched with specific service designation.

2.2 EQUIPMENT LABELS

A. Plastic Labels for Equipment (Indoor Application):
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick.
2. Letter Color: Black

3. Background Color: White
4. Minimum Label Size: Length and width vary for required label content, but not less than 1 by 3 inches.
5. Minimum Letter Size: 1/4 inch.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment (Outdoor Application):
1. Material: MS-215 Max-Tek with printed graphics protected by a chemical and UV resistant MS-3000 top laminate.
2. Letter Color: Black
3. Background Color: White
4. Minimum Label Size: Length and width vary for required label content, but not less than 1 by 3 inches.
5. Minimum Letter Size: 1/4 inch.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.3 PIPE LABELS (INDOOR PIPING)

A. Provide labels for above ground piping located indoors, and not exposed to sunlight or a harsh environment.

B. Pre-printed, color-coded, with lettering indicating service, and showing flow direction.

C. Lettering shall be sub-surface printed and protected from direct contact by a layer of plastic. Markers with surface printed lettering will not be accepted.

D. Pipe Labels for pipe O.D. less than 8 inches: MS-970 Coiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive in contact with the pipe surface.

E. Pipe Labels for pipe O.D. 8 inches and over: MS-970 Strap-on, semi rigid plastic to cover partial circumference of pipe and to attach to pipe with nylon ties

F. Pipe Label Schedule:

Pipe O.D. (including insulation)	Marker Style	Marker Width	Lettering Height	Marker Type
1/4 inch to 3/8 inch	MS970-TM	3 inches	1/4 inch	Coil-on
1/2 inch to 1 inch	MS970-A	8 inches	1/2 inch	Coil-on
1-1/8 inch to 2-1/4	inch MS970-B	8 inches	3/4 inch	Coil-on
2-3/8 inch to 3-1/4	inch MS970-C	12 inches	1-1/4 inch	Coil-on

3-3/8 inch to 4-1/2	inch MS970-D	12 inches	1-1/4 inch	Coil-on
4-5/8 inch to 5-7/8	inch MS970-E	12 inches	1-1/4 inch	Coil-on
6 inch to 7-7/8 inch	MS970-FC	12 inches	1-1/4 inch	Coil-on
8 inch to 10 inch	MS970-G	24 inches	2-1/2 inch	Strap-on
Over 10 inch	MS970-H	32 inches	3-1/2 inch	Strap-on

G. Pipe Label Color Schedule:

Service	Lettering Color	Background Color
Heating Water Piping	White	Green

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4 inch letters for piping abbreviation and 1/2 inch numbers.
1. Tag Material: Brass, 0.032 inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Background Color: Natural brass.
3. Letter Color: Black.
4. Tag Size: 1-1/2 inches, round.
5. Fasteners: Brass S-Hooks and Jack Chain.

B. Valve Tags: For outdoor labeling of process valves.
1. Material: MS-215 Max-Tek with printed graphics protected by a chemical and UV resistant MS-3000 top laminate, and having stainless steel grommet protected predrilled holes with for attachment hardware.
2. Background Color: To match pipe label color by system.
3. Letter Color: Either white or black for best contrast to background color.
4. Tag Size: Minimum 1-1/2 inches.
5. Fasteners: Stainless steel S-Hooks and stainless steel Jack Chain.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Install identifying devices after completion of coverings and painting.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. For labels that are installed using pressure-sensitive adhesives, clean piping and equipment

surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

C. For pipe markers that are pre-coiled or strap-on type and do not adhere directly to the piping, no surface preparation is necessary.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Equipment Labels:
1. Install or permanently fasten labels on each major item of mechanical equipment.
2. Locate equipment labels where accessible and visible.

C. Pipe Labels: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

D. Valve Tags: Install tags on all shut-off valves and control devices in piping systems, except valves within factory-fabricated equipment units.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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

PART 1 - GENERAL

1.1 DESCRIPTION

A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
   1. Planning systematic TAB procedures.
   2. Design Review Report.
   3. Systems Inspection report.
   4. Balancing air distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
   5. Recording and reporting results.

B. Definitions:
   1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of 2007 ASHRAE Handbook, "HVAC Applications".
   2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
   3. AABC: Associated Air Balance Council.
   4. NEBB: National Environmental Balancing Bureau.
   5. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
   6. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

   7.) RGO Inc. shall be only test and balance contractor allowed to bid on test and balance work.

1.2 QUALITY ASSURANCE

A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Qualifications:
   1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
   2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related

Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.

3. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB

C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

D. Tab Criteria:

1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
   a. Air handling unit and all other fans, cubic feet per minute: Minus 0 percent to plus l0 percent.
   b. Air terminal units (maximum values): Minus 2 percent to plus l0 percent.
   c. Minimum outside air: 0 percent to plus 10 percent.
   d. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus l0 percent except if the air to a space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
3. Systems shall be adjusted for energy efficient operation as described in PART 3.

1.4 SUBMITTALS

A. Submit in accordance with Division 01.

B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.

C. For use by the Project Engineer staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.

D. Submit Following for Review and Approval:

1. Design Review Report within 90 days for conventional design projects after the system layout on air side is completed by the Contractor.

2. Systems inspection report on equipment and installation for conformance with design.
3. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, and sound tests.
6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

PART 2 - PRODUCTS

2.1 PLUGS

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

A. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to TAB Criteria in Article, Quality Assurance.

B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

The TAB Specialist shall review the Contract Plans and specifications and advise the Resident Engineer of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEMS INSPECTION REPORT

A. Inspect equipment and installation for conformance with design.

B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4 TAB REPORTS

A. The TAB contractor shall provide raw data immediately in writing to the Project Engineer if there is a problem in achieving intended results before submitting a formal report.

C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval at no additional cost to the owner.

D. Do not proceed with the remaining systems until intermediate report is approved by the Project Engineer.

3.5 TAB PROCEDURES

A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.

B. General: During TAB all related system components shall be in full operation. Fan rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB.

C. Allow 14 days time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include air handling units, fans, room diffusers/outlets/inlets.

1. Artificially load air filters by partial blanking to produce air pressure drop of manufacturer's recommended pressure drop.
2. Record final measurements for furnace equipment performance data sheets.

if determination is made by the Project Engineer based on the recorded sound data.

3.6 MARKING OF SETTINGS

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Resident Engineer.

3.7 IDENTIFICATION OF TEST PORTS

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

END OF SECTION

SECTION 23 07 11
HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. HVAC piping, ductwork and equipment.
   2. Re-insulation of HVAC piping, ductwork and equipment, and boiler plant piping, breeching and stacks and equipment after piping replacement.

B. Definitions
   1. ASJ: All service jacket, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. Cold: Equipment, ductwork or piping handling media at design temperature of 60 degrees F or below.
   4. Concealed: Ductwork and piping above ceilings and in chases, interstitial space, and pipe spaces.
   5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical//, Boiler Plant// and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Density: Pcf - pounds per cubic foot.
   8. Runouts: Branch pipe connections up to one-inch nominal size to fan coil units or reheat coils for terminal units.
   9. Thermal conductance: Heat flow rate through materials.
      a. Flat surface: BTU per hour per square foot.
      b. Pipe or Cylinder: BTU per hour per linear foot.
   10. Thermal Conductivity (k): BTU per inch thickness, per hour, per square foot, per degree F temperature difference.
   11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
   12. HWS: Hot water heating supply.

13. HWR: Hot water heating return.
14. CW: Cold water.
15. HW: Hot water.
16. CHWS: Chilled water supply.
17. CHWR: Chilled water return.
18. RS: Refrigerant suction.

1.2 RELATED WORK

A Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Section 07 84 00, FIRESTOPPING.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Section 23 21 13, HYDRONIC PIPING.

E. Section 23 51 00, BREECHINGS, CHIMNEYS, and STACKS

1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. *(See 4.2.4.2.)*

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

(2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a

similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

//4.3.10.2.6.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics. //

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides

(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.
3. Specified k factors are at 75 degrees F mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
   e. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

A. ASTM C612 (Board, Block), Class 1 or 2, density 3 pcf, k = 0.26 at 75 degrees F, external insulation for temperatures up to 400 degrees F with foil scrim (FSK) facing.

B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 1 pcf, k = 0.31 for use at temperatures up to 400 degrees F with foil scrim (FSK) facing.

C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.26 at 75 degrees F, for use at temperatures up to 450 degrees F with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance $\underline{=}$ 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe

insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

B. ASJ jacket shall be white kraft bonded to 1 mil thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 1-1/2 inch lap on longitudinal joints and minimum 3 inch butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.)in high humidity areas conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 30 inch-pounds for interior locations and 80 inch-pounds for exterior or exposed locations or where the insulation is subject to damage.

E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.

F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.03 inches. Provide color matching vapor retarder pressure sensitive tape.

G. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.023 inch minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.024 inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 0.5 inch wide on 18 inch centers. System shall be weatherproof if utilized for outside service.

2.3 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size inches	Insert Blocks inches
Up through 5	6 long
6	6 long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate for temperatures up to 300 degrees F, cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

2.12 ADHESIVE, MASTIC, CEMENT

A. Class 1: Jacket and lap adhesive and protective finish coating for insulation.
B. Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
C. Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
D. Type I: Protective finish for outdoor use.
E. Type II: Vapor barrier compound for indoor use.
F. Other: Insulation manufacturers' published recommendations.

2.13 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
B. Staples: Outward clinching galvanized steel.
C. Wire: 18 gage soft annealed galvanized or 14 gage copper clad steel or nickel copper alloy.
D. Bands: 0.5 inch nominal width, brass, galvanized steel, aluminum or stainless steel.

2.14 REINFORCEMENT AND FINISHES

A. Glass fiber fitting tape:Type II, Class 1.
B. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
C. Hexagonal wire netting: one inch mesh, 22 gage galvanized steel.
D. Corner beads: 2 inch by 2 inch, 26 gage galvanized steel; or, 1 inch by 1 inch, 28 gage aluminum angle adhered to 2 inch by 2 inch Kraft paper.
E. PVC fitting cover: Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 40 degrees F to 250 degrees F. Below 40 degrees F and above (250 degrees F. Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.15 FIRESTOPPING MATERIAL

Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.16 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 60 degrees F and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 6 inches.

D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

E. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 20 gage galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.

F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

H. HVAC work not to be insulated:
    a. Internally insulated ductwork and air handling units.
    b. Relief air ducts (Economizer cycle exhaust air).
    c. Exhaust air ducts and plenums, and ventilation exhaust air shafts.

d. Equipment: Expansion tanks, flash tanks, hot water pumps.

e. In hot piping: Unions, flexible connectors, control valves, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves. Insulate piping to within approximately 3 inches of uninsulated items.

I. K. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

J. L. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

K. M. Firestop Pipe and Duct insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:

a. Pipe risers through floors

b. Pipe or duct chase walls and floors

c. Smoke partitions

d. Fire partitions

L. O. Provide vapor barrier jackets over insulation as follows:

1. All piping and ductwork exposed to outdoor weather.
2. All interior piping and ducts conveying fluids //exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.)// below ambient air temperature.

M. P. Provide metal jackets over insulation as follows:

1. All piping and ducts exposed to outdoor weather.
2. A 2 inch overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:

a. Faced board: Apply board on pins spaced not more than 12 inches on center each way, and not less than 3 inches from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.

b. Plain board:

c. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 9 inches on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
d. For hot equipment: 1 inch mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 1/4 inch thick, trowel led to a smooth finish.
e. For cold equipment: Apply meshed glass fabric in a tack coat 60 to 70 square feet per gallon of vapor mastic and finish with mastic at 12 to 15 square feet per gallon over the entire fabric surface.
f. Chilled water pumps: Insulate with removable and replaceable 20 gage aluminum or galvanized steel covers lined with insulation. Seal closure joints/flanges of covers with gasket material. Fill void space in enclosure with flexible mineral fiber insulation.
    i. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, interstitial spaces and duct work exposed to outdoor weather:
g. 1-1/2 thick insulation faced with ASJ (white all service jacket): Supply air duct unlined air handling units and after filter housing.
h. 1-1/2 inch thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
i. Outside air intake ducts: one inch thick insulation faced with ASJ.
j. Exposed, unlined supply and return ductwork exposed to outdoor weather: 2 inch thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a maximum water vapor permeability of 0.001 perms.
    i. Cold equipment: 1-1/2inch thick insulation faced with ASJ.
k. Chilled water pumps, water filter, chemical feeder pot or tank.

A. Flexible Mineral Fiber Blanket:
    i. Adhere insulation to metal with 3 inch wide strips of insulation bonding adhesive at 8 inches on center all around duct. Additionally secure insulation to bottom of ducts exceeding 24 inches in width with pins welded or adhered on 18 inch centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.

ii. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.

iii. Concealed supply air ductwork.

b. Above ceilings at a roof level, in attics, and duct work exposed to outdoor weather: 2 inch thick insulation faced with FSK.

c. Above ceilings for other than roof level: 1 ½ inch thick insulation faced with FSK.

i. Concealed return air duct:

B. In attics (where not subject to damage) and where exposed to outdoor weather: 2 inch thick insulation faced with FSK.

C. Above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 1-1/2 inch thick, insulation faced with FSK.

a. //c. In interstitial spaces (where not subject to damage): 1-1/2 inch thick insulation faced with FSK.

D. Concealed return air ductwork in other locations need not be insulated.

i. Concealed outside air duct: 1-1/2 inch thick insulation faced with FSK.

b. Molded Mineral Fiber Pipe and Tubing Covering:

i. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.

ii. Contractor's options for fitting, flange and valve insulation:

E. Insulating and finishing cement for sizes less than 4 inches operating at surface temperature of 61 degrees F or more.

F. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 40 degrees F, or above 250 degrees F. Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.

G. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 60 degrees F or less, vapor seal with a layer of glass fitting tape imbedded between two 1/16 inch coats of vapor barrier mastic.

H. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 2 inches.

~~i.~~ Nominal thickness in inches specified in the schedule at the end of this section.

b. Rigid Cellular Phenolic Foam:
   i. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 250 degrees F.
   ii. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B
   iii. Provide secure attachment facilities such as welding pins.
   iv. Apply insulation with joints tightly drawn together
   v. Apply adhesives, coverings, neatly finished at fittings, and valves.
   vi. Final installation shall be smooth, tight, neatly finished at all edges**.**
   vii. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
   viii. Exposed, unlined supply and return ductwork exposed to outdoor weather: 2 inch thick insulation faced with a multi-layer vapor barrier with a maximum water vapor permeance of 0.00 perms.
   ix. Condensation control insulation: Minimum 1.0 inch thick for all pipe sizes.

I. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

J. Flexible Elastomeric Cellular Thermal Insulation:
   a. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
   b. Pipe and tubing insulation:
      i. Use proper size material. Do not stretch or strain insulation.
      ii. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
   c. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
   ~~d.~~ Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
   e. Minimum 0.75 inch thick insulation for pneumatic control lines for a minimum distance of 20 feet from discharge side of the refrigerated dryer.

f. Use Class S (Sheet), 3/4 inch thick for the following:

i. Chilled water pumps

3.3 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Wall Thickness Inches					
		Nominal Pipe Size Inches			
Operating Temperature Range/Service	Insulation Material	Less than 1	1 – 1¼	1½ - 3	4 and Above
	Insulation Wall Thickness Inches				
100-200 degrees F) (HWS and HWR)	Mineral Fiber (Above ground piping only)	1.5	1.5	2.0	2.0
100-200 degrees F (Refrigerant Piping)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	1.5	1.5	----	----
40-60 degrees F (CHWS and CHWR)	Cellular Glass Closed-Cell	1.5)	1.5	1.5	1.5

- - - E N D - - -

SECTION 23 11 23
FACILITY NATURAL PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

Fuel gas systems, including piping, equipment and all necessary accessories as designated in this section. Fuel gas piping for central boiler plants is not included.

1.2 RELATED WORK

A. Division 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Division 07, FIRESTOPPING.

C. Division 07, JOINT SEALANTS.

D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

E. Section 22 05 23, GENERAL DUTY VALVES FOR PLUMBING PIPING

1.3 SUBMITTALS

A. Submit in accordance with Division 01, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Pipe & Fittings.
2. Valves.
3. Strainers.
4. All items listed in Part 2 - Products.

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

PART 2 - PRODUCTS

2.1 FUEL GAS SERVICE CONNECTIONS TO BUILDING

A. From inside face of exterior wall to a distance of approximately 5 feet outside of building, use coated piping.

B. Pipe: Black steel, ASTM A53, Schedule 40. Shop-applied pipe coating shall be one of the following types:

1. Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous glass mat as specified in Appendix Section A2.1 of AWWA C203.
2. Adhesive-thermoplastic Resin Coating: Fed. Spec. L-C-530, Type I
3. Thermosetting Epoxy Coating: Fed. Spec. L-C-530, Type II

C. Fittings:

1. Butt weld fittings, wrought steel, ANSI B16.9.
2. Socket weld and threaded fittings forged steel, ANSI B16.11.

D. Joints: Welded, ANSI B31.8.

2.2 FUEL GAS PIPING

A. Pipe: Black steel, ASTM A53, Schedule 40.

B. Nipples: Steel, ASTM A733, Schedule 40.

C. Fittings:

1. 2 inch under ANSI B 16.3 threaded malleable iron.
2. 2 inch and up to 100 mm (4 inch) ANSI B16.11 socket welded.

D. Joints: Provide welded or threaded joints.

2.3 EXPOSED FUEL GAS PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed fuel gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight
2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
3. Nipples: ASTM B 687, Chromium-plated.
4. Unions: 2 inches and smaller Mss SP-72, SP-110, Brass or Bronze threaded with chrome finish. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.
5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required.

2.4 VALVES

A. Ball Valve: Bronze body, rated for 150 psi at 365ºF, 250 psi at 250ºF, reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services.

B. Gas Vent Cocks: Type 701: Bronze body, tee handle, rated for 30 psi at 100ºF, ground plug, rated for tight shut-off on fuel gas service.

2.5 WATERPROOFING

A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on drawings.

2.6 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.

C. Body: Smaller than 3 inches, brass or bronze; 3 inches and larger, cast iron or semi-steel.

2.7 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.8 GAS EQUIPMENT CONNECTORS

Flexible connectors with teflon core, interlocked galvanized steel protective casing, AGA certified design.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Fuel Gas Code and the following:
   1. Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the or specified in other sections.
   2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, shall be reamed to full size after cutting.
   3. All pipe runs shall be laid out to avoid interference with other work.
   4. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.
   5. Install union and shut-off valve on pressure piping at connections to equipment.
   6. Pipe Hangers, Supports and Accessories:
      a. All piping shall be supported per the International Fuel Gas Code, Chapter No. 4.
      b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
      c. Floor, Wall and Ceiling Plates, Supports, Hangers:
         1) Solid or split unplated cast iron, chrome plated in finished areas.
         2) All plates shall be provided with set screws.
         3) Pipe Hangers: Height adjustable clevis type.
         4) Adjustable Floor Rests and Base Flanges: Steel.
         5) Concrete Inserts: "Universal" or continuous slotted type.
         6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
         7) Riser Clamps: Malleable iron or steel.
         8) Rollers: Cast iron.
         9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
         10) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.

7. Install cast chrome plated escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
8. Penetrations:
   a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Division 07, FIRESTOPPING. Completely fill and seal clearances between piping and openings with the fire stopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Division 07, JOINT SEALANTS.

B. Piping shall conform to the following:
   1. Fuel Gas:
      a. Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.
      b. Provide fuel gas piping with plugged drip pockets at low points.

3.2 CLEANING OF SYSTEM AFTER INSTALLATION

Clean all piping systems to remove all dirt, coatings and debris. Remove all valves, controls etc., and reinstall after piping system has been cleaned.

3.3 TESTS

A. General: Test system either in its entirety or in sections after system is installed or cleaned.
B. Test shall be made in accordance with Section 406 of the International Fuel Gas Code. The system shall be tested at a minimum of 1.5 times maximum working pressure, but not less than 3 psig.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Water piping to connect HVAC equipment, including the following:
   1. Chilled water, heating hot water and drain piping.
   2. Extension of domestic water make-up piping for HVAC systems.
   3. Glycol-water piping.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
D. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
E. Section 23 07 11, HVAC INSULATION.
F. Section 23 21 23, HYDRONIC PUMPS.
G. Section 23 25 00, HVAC WATER TREATMENT.

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING”, with applicable paragraph identification.
C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. Pipe and equipment supports.
   2. Pipe and tubing, with specification, class or type, and schedule.
   3. Pipe fittings, including miscellaneous adapters and special fittings.
   4. Flanges, gaskets and bolting.
   5. Couplings and fittings.
   6. Valves of all types.
   7. Strainers.
   8. Flexible connectors for water service.
   9. Pipe alignment guides.
   10. Expansion joints.
   11. Expansion compensators.

12. All specified hydronic system components.
13. Water flow measuring devices.
14. Gauges.
15. Thermometers and test wells.
16. Heat exchangers (Water to Water).
17. Air separators.
18. Expansion tanks.
19. Buffer tanks.

D. Submit the welder's qualifications in the form of a current (less than 1-year old) and formal certificate.

E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawings as follows for chilled water, condenser water, and heating hot water system and other piping systems and equipment.
1. 1 complete set of reproducible drawings.
2. 1 complete set of drawings in electronic AutoCAD and pdf format.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.4 QUALITY ASSURANCE

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than 1-year old.

C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.5 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.6 SPARE PARTS

A. For mechanical pressed sealed fittings provide tools required for each pipe size used at the facility.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

A. Chilled Water, Heating Hot Water, Glycol-Water, and Vent Piping:
   1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
   2. Copper Water Tube Option: ASTM B88, Type L, hard drawn 3/4 inch and larger, shall be used for runouts routed under slab to floor mounted fan coil units.

B. Extension of Domestic Water Make-up Piping: ASTM B88, Type L, hard drawn copper tubing.

C. Cooling Coil Condensate Drain Piping:
   1. From Fan Coil or Other Terminal Units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.

D. Pipe supports, including insulation shields, for aboveground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 FITTINGS FOR STEEL PIPE

A. 2 inches and Smaller: welded joints.
   1. Butt Welding: ASME B16.9 with same wall thickness as connecting piping.
   2. Forged Steel, Socket Welding or Threaded: ASME B16.11.
   3. Unions: ASME B16.39.
   4. Water Hose Connection Adapter: Brass, pipe thread to 19 mm (3/4 inch) garden hose thread, with hose cap nut.

B. 2-1/2 inches and Larger: Welded or flanged joints.
   1. Butt Welding Fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
   2. Welding Flanges and Bolting: ASME B16.5:
      a. Water Service: Weld neck or slip-on, plain face, with 1/8 inch thick full-face neoprene gasket suitable for 220 degrees F.
         1) Contractor's Option: Convoluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.
      b. Flange Bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets shall be used for branch connections up to 1 pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 shall be used for drain, vent, and gauge connections.

2.4 FITTINGS FOR COPPER TUBING

A. Joints:
Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.5 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 2 inches)and Smaller: Threaded dielectric union, ASME B16.39.

C. 2-1/2 inches and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.

D. Temperature Rating: 210 degrees F.

2.6 VALVES

A. Asbestos packing is prohibited.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 6 inches and larger when the centerline is located 8 feet or more above the floor or operating platform.

D. Shut-Off Valves:

1. Ball Valves (Pipe Sizes 2 inch and Smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 400 psig working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
2. Butterfly Valves (Pipe Sizes 2-1/2 inch) and Larger): Provide stem extension to allow 2 inches of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 175 psig working pressure at 200 degrees F. Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Butterfly valves are prohibited for direct buried pipe applications.
    a. Body: Cast-iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
    b. Trim: Bronze, aluminum bronze, or 300 series stainless-steel disc, bronze bearings, 316 stainless-steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the

product. A phosphate coated steel shaft or stem is acceptable if the stem is completely isolated from the product.

3. Gate Valves:
   a. 2 inches and Smaller: MSS SP-80, Bronze, 150 psig, wedge disc, rising stem, union bonnet.
   b. 2-1/2 inches and Larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 125 psig wedge disc.
4. Field Interchangeable Actuators: Valves for balancing service shall have adjustable memory stop to limit open position.
   a. Valves 6 inches and Smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.

E. Globe and Angle Valves:
   1. Globe Valves:
      a. 2 inches and Smaller: MSS SP-80, bronze, 150 psig Globe valves shall be union bonnet with metal plug type disc.
      b. 2-1/2 inches and Larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for globe valves.
   2. Angle Valves:
      a. 2 inches and Smaller: MSS SP-80, bronze, 150 psig Angle valves shall be union bonnet with metal plug type disc.
      b. 2-1/2 inches and Larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for angle.

F. Check Valves:
   1. Swing Check Valves:
      a. 2 inches and Smaller: MSS SP-80, bronze, 50 psig, 45-degree swing disc.
      b. 2-1/2 inches and Larger: 125 psig, flanged, iron body, bronze trim, MSS SP-71 for check valves.
   2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
      a. Body: MSS SP-125 cast-iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.
      b. Seat, Disc and Spring: 18-8 stainless-steel, or bronze, ASTM B62. Seats may be elastomer material.

G. Water Flow Balancing Valves: For flow regulation. Provide separate isolation valve. Valves shall be sized to provide the needed pressure drop in the middle of their throttling range.
   1. Ball style valve.
   2. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
   3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

H. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of 4 to 57 psig Provide standard pressure taps and 4 sets of capacity charts. Valves shall be line size and be one of the following designs:
   1. Gray iron ASTM A126 or brass body rated 175 psig at 200 degrees F, with stainless-steel piston and spring.
   2. Brass or ferrous body designed for 300 psig service at 250 degrees F, with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
   3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.

2.7 STRAINERS

A. Y Type.
   1. Screens: Bronze, Monel metal or 18-8 stainless-steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 0.045 inch diameter perforations for 4 inches and larger: 1/8 inch diameter perforations.

B. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.8 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:
   1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
   2. Working pressures and temperatures shall be as follows:
      a. Connector sizes 2 inches to 4 inches, 165 psig at 250 degrees F.
      b. Connector sizes 5 inches to 12 inches, 140 psig at 250 degrees F.
   3. Provide ductile iron retaining rings and control units.

B. Braided Hose: Corrugated-metal inner hose and braided outer shell.
   1. Piping Up To 2 inches: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 degrees F and 340 psig at 450 degrees F ratings.
   2. Piping From 2-1/2 inches to 4 inches: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 degrees F and 225 psig at 450 degrees F ratings.
   3. Piping 6 inches and Above: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 degrees F and 145 psig at 600 degrees F ratings.

2.9 HYDRONIC SYSTEM COMPONENTS

A. Air Purger: Cast-iron or fabricated steel, 125 psig water working pressure, for in-line installation.

B. Tangential Air Separator: ASME BPVC Section VIII construction for 125 psig working pressure, flanged tangential inlet and outlet connection, internal perforated stainless-steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. Provide Form No. U-1. If scheduled in the contract documents, provide a removable stainless-steel strainer element having 3/16 inch perforations and free area of not less than five times the cross-sectional area of connecting piping.

C. Diaphragm Type Pre-Pressurized Expansion Tank: ASME BPVC Section VIII construction for 125 psig working pressure, welded steel shell, rustproof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 240 degrees F. Provide Form No. U-1. Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre-charged to a minimum of 12 psig.

D. Pressure Relief Valve: Bronze or iron body and bronze or stainless-steel trim, with testing lever. Comply with ASME BPVC Section VIII and bear ASME stamp.

E. Automatic Air Vent Valves: Where shown in the contract documents, cast-iron or semi-steel body, 150 psig working pressure, stainless-steel float, valve, valve seat and mechanism, minimum 1/2 inch water connection and 1/4 inch air outlet. Air outlet shall be piped to the nearest floor drain.

2.10 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 4-1/2 inches in diameter, 1/4 inch NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gauges in water service.

C. Range of Gauges: Provide range equal to at least 130 percent of normal operating range.
   1. For Condenser Water Suction (Compound): 100 psig.

2.11 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Pete's Plug: 1/4 inch MPT by 3 inches long, brass body and cap, with retained safety cap, Nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown in the contract documents.

2.12 THERMOMETERS

A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 6 inch brass stem, straight, fixed or adjustable angle as required for each in reading.
B. Case: Chrome plated brass or aluminum with enamel finish.
C. Scale: Not less than 9 inches, range as described below, 2-degree graduations.
D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
E. Scale Ranges:
   1. Chilled Water and Glycol-Water: 32 to 100 degrees F.
   2. Hot Water and Glycol-Water: 100 to 200 degrees F.

2.13 FIRESTOPPING MATERIAL

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contract documents show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location in the contract documents shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC
D. Install piping generally parallel to walls and column center lines, unless shown otherwise in the contract documents. Space piping, including insulation, to provide 1 inch minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 1 inch in 40 feet. Provide eccentric reducers to keep bottom of sloped piping flat.
E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect

to pipe sizes shown in the contract documents. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted in the contract documents.

G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

H. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

I. Connect piping to equipment as shown in the contract documents. Install components furnished by others such as:
   1. Water treatment pot feeders and condenser water treatment systems.
   2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

J. Thermometer Wells: In pipes 63 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

L. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M. See Welder’s qualification requirements in paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. 125 Pound Cast-Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast-iron flange.

C. Solvent Welded Joints: As recommended by the manufacturer.

3.3 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary to the satisfaction of the owner. Tests shall be either of those below, or a combination, as approved by the owner.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.4 FLUSHING AND CLEANING PIPING SYSTEMS

A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

B. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 5.9 f/s, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the owner.

C. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system, if possible, to circulate at velocities not less than 5.9 f/s. Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.

D. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.5 WATER TREATMENT

A. Install water treatment equipment and provide water treatment system piping.

B. Close and fill system as soon as possible after final flushing to minimize corrosion.

C. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

3.6 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the owner.
C. Adjust red set hand on pressure gauges to normal working pressure.

3.7 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hour//s to instruct each owner personnel responsible in operation and maintenance of the system.

- - - E N D - - -

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Hydronic pumps for heating, ventilating and air conditioning.

B. Definitions:

1. Capacity: Liters per second Gallons per minute (gpm) of the fluid pumped.
2. Head: Total dynamic head in feet of the fluid pumped.
3. Flat head-capacity curve: Where the shutoff head is less than 1.16 times the head at the best efficiency point.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.//

D. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

E. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

F. Section 23 21 13, HYDRONIC PIPING.

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION XX XX XX, SECTION TITLE”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pumps and accessories.
2. Motors and drives.
3. Variable speed motor controllers.

D. Characteristic Curves: Head-capacity, efficiency-capacity, brake horsepower-capacity, and NPSHR-capacity for each pump and for combined pumps in parallel or series service. Identify pump and show fluid pumped, specific gravity, pump speed and curves plotted from zero flow to maximum for the impeller being furnished and at least the maximum diameter impeller that can be used with the casing.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.4 QUALITY ASSURANCE

A. Design Criteria:
   1. Pumps design and manufacturer shall conform to Hydraulic Institute Standards.
   2. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
   3. Head-capacity curves shall slope up to maximum head at shut-off.. Select pumps near the midrange of the curve, so the design capacity falls to the left of the best efficiency point, to allow a cushion for the usual drift to the right in operation, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA). Provide pumps with non-overloading motors.
   4. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve, including in a parallel or series pumping installation with one pump in operation.
   5. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
   6. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in gpm and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency. Name plates shall be visible when pumps are insulated.
   7. Test all pumps before shipment. The manufacturer shall certify all pump ratings.
   8. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.

B. Allowable Vibration Tolerance for Pump Units: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

C. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.5 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.6 SPARE MATERIALS

A. Furnish one spare seal and casing gasket for each pump to the Project Manage.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL PUMPS, BRONZE FITTED

A. General:
   1. Provide pumps that will operate continuously without overheating bearings or motors at every condition of operation on the pump curve, or produce noise audible outside the room or space in which installed.
   2. Provide pumps of size, type and capacity as indicated, complete with electric motor and drive assembly, unless otherwise indicated. Design pump casings for the indicated working pressure and factory test at 1-1/2 times the designed pressure.
   3. Provide pumps of the same type, the product of a single manufacturer, with pump parts of the same size and type interchangeable.
   4. General Construction Requirements:
      a. Balance: Rotating parts, statically and dynamically.
      b. Construction: To permit servicing without breaking piping or motor connections.
      c. Pump Motors: Provide high efficiency motors, inverter duty for variable speed service. Refer to Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT. Motors shall be //open drip-proof// //TEFC// and operate at 1750 RPM unless noted otherwise.
      d. Heating pumps shall be suitable for handling water to 107 degrees C (225 degrees F).
      e. Provide coupling guards that meet OSHA requirements.
      f. Pump Connections: Flanged.
      g. Pump shall be factory tested.
      h. Performance: As scheduled in the contract documents.
   5. Variable Speed Pumps:
      a. The pumps shall be the type shown in the contract documents and specified herein flex coupled to //an open drip proof a TEFC motor.
      b. Variable Speed Motor Controllers: Refer to Section 26 29 11, MOTOR CONTROLLERS and to Section 23 05 11, COMMON WORK RESULTS FOR HVAC paragraph, VARIABLE SPEED MOTOR CONTROLLERS. Furnish controllers with pumps and motors.
      c. Pump operation and speed control shall be as shown in the contract documents.

d. Direct drive pumps with integrated variable frequency drive (VFD) utilizing the design pump curve programmed on board the built-in controller (also known as sensor-less, or self-sensing). Pump to comply with paragraphs in this section. VFD and motor to comply with Section 26 29 11, MOTOR CONTROLLERS and Section 23 05 12

B. Inline Type, Base Mounted End Suction or Double Suction Type:
   1. Casing and Bearing Housing: Close-grained cast-iron, ASTM A48/A48M.
   2. Casing Wear Rings: Bronze.
   3. Suction and Discharge: //Plain face flange, 861 kPa (125 psig), ASME B16.1 //Union End//.
   4. Casing Vent: Manual brass cock at high point.
   5. Casing Drain and Gauge Taps: 13 mm (1/2 inch) plugged connections minimum size.
   6. Impeller: Bronze, ASTM B62, enclosed type, keyed to shaft.
   7. Shaft: Steel, Type 1045 or stainless-steel.
   8. Shaft Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and //NBR// //EPDM// //FKM// // // bellows and gasket.
   9. Shaft Sleeve: Bronze or stainless-steel.
   10. Motor: Furnish with pump. Refer to Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

C. Base Mounted Pumps:
   a. Designed for disassembling for service or repair without disturbing the piping or removing the motor.
   b. Impeller Wear Rings: Bronze.
   c. Shaft Coupling: Non-lubricated steel flexible type or spacer type with coupling guard, bolted to the baseplate.
   d. Bearings (Double-Suction pumps): Regreaseable ball or roller type.
   e. Provide lip seal and slinger outboard of each bearing.
   f. Base: Cast-iron or fabricated steel for common mounting to a concrete base.
   2. Provide line sized shut-off valve and suction strainer, maintain manufacturer recommended straight pipe length on pump suction (with blowdown valve). Contractor option: Provide suction diffuser as follows:
      a. Body: Cast-iron with steel inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16 inch diameter openings for pump protection. Provide taps for strainer blowdown and gauge connections.
      b. Provide adjustable foot support for suction piping.
      c. Strainer free area: Not less than 5 times the suction piping.
      d. Provide disposable startup strainer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the owner, the contractor shall correct the installation at no additional cost or time to the Government.
B. Follow manufacturer's written instructions for pump mounting and startup. Access/Service space around pumps shall not be less than minimum space recommended by pumps manufacturer.
C. Provide drains for bases and seals for base mounted pumps, piped to and discharging into floor drains.
D. Coordinate location of thermometer and pressure gauges as per Section 23 21 13, HYDRONIC PIPING.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
B. When any defects are detected, correct defects and repeat test at no additional cost or time to the owner.
C. Verify that the piping system has been flushed, cleaned and filled.
D. Lubricate pumps before startup.
E. Prime the pump, vent all air from the casing and verify that the rotation is correct. To avoid damage to mechanical seals, never start or run the pump in dry condition.
F. Verify that correct size heaters-motor over-load devices are installed for each pump controller unit.
G. Field modifications to the bearings and or impeller (including trimming) are prohibited. If the pump does not meet the specified vibration tolerance, send the pump back to the manufacturer for a replacement pump. All modifications to the pump shall be performed at the factory.
H. Ensure the disposable strainer is free of debris prior to testing and balancing of the hydronic system.
I. After several days of operation, replace the disposable startup strainer with a regular strainer in the suction diffuser.

3.3 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each owner’s personnel responsible in operation and maintenance of the system.

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SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions:

1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
    a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
    b. High side means the parts of a refrigerating system subjected to condenser pressure.
2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 840 degrees F but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Section 23 21 13, HYDRONIC PIPING.

D. Section 23 81 43, AIR-SOURCE UNITARY HEAT PUMPS

1.3 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 23 00, REFRIGERAN PIPING", with applicable paragraph identification.

C. Shop Drawings:

1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with in the contract documents for components noted below:
    a. Tubing and fittings
    b. Valves

c. Strainers
d. Moisture-liquid indicators
e. Filter-driers
f. Flexible metal hose
g. Liquid-suction interchanges
h. Oil separators (when specified)
i. Gauges
j. Pipe and equipment supports
k. Refrigerant and oil
l. Pipe/conduit roof penetration cover
m. Soldering and brazing materials

2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

D. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.

E. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.4 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

D. Products shall comply with UL 207 "Refrigerant–Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

E. Categorize selected refrigerant with ASHRAE 34-2022. Submit selected refrigerant for information.

1.5 AS-BUILT DOCUMENTATION

A. Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Refrigerant Piping: For piping up to 4 inch use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer.

B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L). Optional drain piping material: Schedule 80 flame retardant Polypropylene plastic.

C. Fittings, Valves and Accessories:
   1. Copper fittings: Wrought copper fittings, ASME B16.22.
      a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
      b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
   2. Steel fittings: ASTM wrought steel fittings.
      a. Refrigerant piping – Welded Joints.
   3. Flanges and flanged fittings: ASME B16.24.
   4. Refrigeration Valves:
      a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
      b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
      c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally // open // closed // holding coil.
      d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive nonferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
      e. Electronic Thermostatic Expansion Valves: Electronic thermal expansion valves shall be stepper motor high resolution drive assembly type for precision control. Valve shall not exceed 6 watts max consumption. Compatibility tested with most HC, CFC, HCFC, and HFC refrigerants and oils. Valve pistons and ports to be characterized to provide improved flow resolution and performance. Valves to be interfaced with microprocessor-based controllers by devise manufacturer with temperature feedback loop. Electric expansion valves to be sized with nominal steps of stroke for tonnage application as recommended by valve manufacture ranging from 500 steps on small tonnage (under 5 tons per circuit) to 6300 on large tonnage circuits (over 100 tons per circuit)

f. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.

5. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines greater than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
6. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
7. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown in the contract documents. Conform to ARI Standard 730. Heavy gauge steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.
8. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.

2.2 PIPE SUPPORTS

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 PIPE/CONDUIT ROOF PENETRATION COVER

A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 12 inches overall height, continuous welded corner seams, treated wood nailer,1-1/2 inch thick, 3 pounds/cubic foot density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 1-1/2 inch thick mineral fiber board insulation.

C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
   1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
   2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
   3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents.
   4. Use copper tubing in protective conduit when installed below ground.
   5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

B. Joint Construction:
   1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
      a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
      b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
      c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
      d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.

D. Pipe relief valve discharge to outdoors for systems containing greater than 45 kg (100 lbs) of refrigerant.

E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, and BOILER PLANT INSULATION.

3.2 PIPE AND TUBING INSULATION

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

B. Systems containing greater than 110 lb of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 1/2 inch in height designating:

1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
2. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."
3. Signage and labeling identifying “flammable” or “health hazard” based on chosen refrigerant per requirements and definitions in ASHRAE 34-2022.

3.4 FIELD QUALITY CONTROL

A. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of owner. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.

1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding NPS 5/8. This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68 degrees F minimum.

C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gauge on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

A. Ensure qualified workers are competent in the application of chosen refrigerant per ASHRAE 15 and ASHRAE 34. System Test and Charging: As recommended by the equipment manufacturer or as follows:

1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 10 psig gauge. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gauge reading in mPa (microns). Pull the system down to 2245.6 inches of mercury at 60 degrees F and hold for 8 hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

3.6 STARTUP AND TESTING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.7 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct owner’s personnel in operation and maintenance of units.

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SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies cleaning and treatment of circulating HVAC water systems, including the following.
   1. Cleaning compounds.
   2. Chemical treatment for closed loop heat transfer systems.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
C. Section 23 21 13, HYDRONIC PIPING.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, QUALITY ASSURANCE in Section 23 05 11, COMMON WORK RESULTS FOR HVAC .

B. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than 6 service calls and written status reports. Emergency calls are not included. Minimum service during construction/start-up shall be 6 hours.

E. Chemicals: Chemicals shall be non-toxic approved by local authorities and meeting applicable EPA requirements.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Manufacturer's Literature and Data including:
   1. Cleaning compounds and recommended procedures for their use.
   2. Chemical treatment for closed systems, including installation and operating instructions.
   3. Water analysis verification.
D. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B-005-4.

1.5 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):
70-2008 ..... National Electric Code (NEC)

C. American Society for Testing and Materials (ASTM):
F441/F441M-02 (2008) ..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

PART 2 - PRODUCTS

2.1 CLEANING COMPOUNDS

A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

B. All chemicals to be acceptable for discharge to sanitary sewer.

C. Refer to Section 23 21 13, HYDRONIC PIPING for flushing and cleaning procedures.

2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS

A. Inhibitor: Provide sodium nitrite/borate, molybdate-based inhibitor or other approved compound suitable for make-up quality and make-up rate and which will cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.5.

C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0-2; brass, 0-1; copper, 0-1. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of not less than 250 degrees F and 125 degrees Fahrenheit respectively. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005.

D. Pot Feeder: By-pass type, complete with necessary shut off valves, drain and air release valves, and system connections, for introducing chemicals into system, cast iron or steel tank with funnel or large opening on top for easy chemical addition. Feeders shall be five gallon minimum capacity at 125 psig minimum working pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.

B. Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.
C. Refer to Section 23 21 13 HYDRONIC PIPING for chemical treatment piping, installed as follows:
D. Before adding cleaning chemical to the closed system, all air handling coils and fan coil units should be isolated by closing the inlet and outlet valves and opening the bypass valves. This is done to prevent dirt and solids from lodging the coils.
E. Do not valve in or operate system pumps until after system has been cleaned.
F. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the by-pass valves. Also, clean all strainers.
G. After cleaning is complete, and water PH is acceptable to manufacturer of water treatment chemical, add manufacturer-recommended amount of chemicals to systems.

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SECTION 23 31 00
HVAC DUCTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Ductwork and accessories for HVAC including the following:
   1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.
B. Definitions:
   1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
   2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
   3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
   4. Exposed Duct: Exposed to view in a finished room.

1.3 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
B. Fire Safety Code: Comply with NFPA 90A.
C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.4 SUBMITTALS

A. Submit in accordance with Division 01.
B. Manufacturer's Literature and Data:
   1. Rectangular ducts:
      a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
      b. Duct liner.
      c. Sealants and gaskets.
      d. Access doors.
   2. Round duct construction details:

a. Manufacturer's details for duct fittings.
b. Duct liner.
c. Sealants and gaskets.
d. Access sections.
e. Installation instructions.

3. Volume dampers, back draft dampers.
4. Upper hanger attachments.
5. Flexible ducts and clamps, with manufacturer's installation instructions.
6. Flexible connections.
7. Instrument test fittings.

C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11 – Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.

B. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

C. Approved factory made joints may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:

B. Duct Pressure Classification:

2 inch

C. Seal Class: All ductwork shall receive Class A Seal

D. Round Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on

the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.

1. Elbows: Diameters 3 through 8 inches shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam.
2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
3. Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
    a. Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
    b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Resident Engineer.

E. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.

F. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

2.3 DUCT LINER (WHERE INDICATED ON DRAWINGS)

A. Duct sizes shown on drawings for lined duct are clear opening inside lining.

B. Duct liner is only permitted to be used for return, relief and general exhaust ducts. Duct liner is not permitted for outside air ducts, supply air ducts or any other positive pressure ductwork (provide exterior insulation only).

C. Rectangular Duct or Casing Liner: ASTM C1071, Type I (flexible), or Type II (board), one inch minimum thickness, applied with mechanical fasteners and 100 percent coverage of adhesive in conformance with SMACNA, Duct Liner Application Standard.

D.

2.4 FLEXIBLE AIR DUCT

A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 5 feet. Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 8 inches in diameter shall be Class 1.

C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 75 degrees F mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per foot of straight duct, at 500 Hz, based on 6 inch duct, of 2500 fpm.

D. Application Criteria:

1. Temperature range: 0 to 200 degrees F internal.
2. Maximum working velocity: 4000 feet per minute.
3. Minimum working pressure, inches of water gage: 10 inches positive, 2 inches negative.

E. Duct Clamps: 100 percent nylon strap, 175 pounds minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.5 FLEXIBLE DUCT CONNECTIONS

A. Where duct connections are made to fans, air terminal units, and air handling units, install a non-combustible flexible connection of 29 ounce neoprene coated fiberglass fabric approximately 6 inches wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 2 inches on center. Fabric shall not be stressed other than by air pressure. Allow at least one inch slack to insure that no vibration is transmitted.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Combination fire and smoke dampers: Multi-blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:

1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the

government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.

D. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

E. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 5 feet long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.

F. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

G. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.

H. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

I. Install combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the Project Engineer. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant

springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the Project Engineer.

3.2 DUCT LEAKAGE TESTS AND REPAIR

A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.
B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections.
C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
E. All tests shall be performed in the presence of the Project Engineer and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Project Engineer and identify leakage source with excessive leakage.
F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Project Engineer.
G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.3 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.5 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

1.2 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Fire Safety Code: Comply with NFPA 90A.

1.3 SUBMITTALS

A. Submit in accordance with Division 01.

B. Manufacturer's Literature and Data:

1. Diffusers, registers, grilles and accessories.

C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 AIR OUTLETS AND INLETS

A. Materials:

1. Steel or aluminum. Provide manufacturer's standard gasket.
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.

B. Performance Test Data: In accordance with Air Diffusion Council Code 1062GRD.

C. Air Supply Outlets:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the drawings. Provide plaster frame for units in plaster ceilings.
   a. Square, louver, fully adjustable pattern: Round neck, surface mounting unless shown otherwise on the drawings. Provide equalizing or control grid and volume control damper.
   b. Louver face type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.

   .
2. Linear Bar Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
   a. Margin Frame: Flat, 20 mm (3/4 inch) wide.

b. Bars: Minimum 3/16 inch wide by 3/4 inch deep, zero deflection unless otherwise shown. Bar spacing shall be a minimum of 1/8 inch on center. Reinforce bars on 18 inch center for sidewall units and on 6 inch center for units installed in floor or sills.
c. Provide opposed blade damper and equalizing or control grid where shown.

3. Supply Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
a. Margin: Flat, 1-1/4 inches wide.
b. Bar spacing: 3/4 inch maximum.
c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded with manufacturer's standard finish.

D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.
2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 1-1/4 inch margin.
3. Perforated Face Type: To match supply units.
4. Grid Core Type: 1/2 inch by 1/2 inch core with 1-1/4 inch margin.
5. Linear Type: To match supply units.

G. Acoustic Transfer Grille: Aluminum, suitable for partition or wall mounting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

B. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.2 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.4 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

END OF SECTION

SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 – GENERAL:

1.1 DESCRIPTION:

This section specifies flue gas exhaust system and all accessories from the boiler outlet to the stack outlet to the atmosphere. Flue gas recirculation (FGR) ductwork (if required by burners furnished) is also specified.

1.2 RELATED WORK:

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
B. Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.
C. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.
D. Section 23 52 39, CONDENSING FIRE-TUBE BOILERS

1.3 QUALITY ASSURANCE:

A. Provide scale drawings showing nominal dimensions and weight of the systems.
B. Boiler and burner manufacturer shall review complete system from boiler flue gas outlet to stack outlet to atmosphere and advise the Government of any changes required to meet boiler and burner performance requirements. Note the altitude of plant site.
C. If a double wall, factory-fabricated, positive pressure breeching and stack system is provided, the manufacturer shall completely engineer the entire system and provide all components. Manufacturer's representative shall provide installation instructions prior to start of construction, train the installers and certify in writing to the Resident Engineer (RE) that the entire installation complies with the official standards of the manufacturer and with the project specifications.
D. Conform to NFPA 54 and NFPA 31 for installation of fuel burning equipment and appliances.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Design, materials, weights, construction, pressure and temperature limitations of breeching and stack systems, flue gas recirculation system. //Seismic design data. //
C. Drawings showing all components, system arrangement and dimensions.
D. Design, construction, allowable movements, movement forces, pressure and temperature limitations of expansion joints.
E. Damper design, construction, pressure and temperature limitations, pressure loss at design flow, and leakage of closed damper.
F. Support designs, locations and loads for entire assembly.
G. Written statement from boiler/burner manufacturer that the design of the system is satisfactory to achieve the required boiler/burner performance.

1PART 2 – PRODUCTS:

2.1 SPECIAL GAS VENT

A. Vent shall be factory-built special gas type, single wall, engineered and designed for use on Category I, II, III, and IV appliances, or as specified by the equipment manufacturer.

B. Maximum continuous flue gas temperature shall not exceed 550 degrees Fahrenheit (288 degrees Celsius).

C. Vent shall be constructed of AL29-4C® or 29-4 (S44735) superferritic stainless steel with a minimum thickness of .015” for diameters 3”-8” and .020” for diameters 10”-16”.

D. All conduit components shall be manufactured from AL29-4C®, or 29-4 (S44735). The joint closure system shall be a Ring-and-Tab mechanism that is integral to each joint. Joints shall not use screws or fasteners that penetrate the pipe.

E. Vent shall be constructed with a factory installed gasket used to seal the joint. Use of gasket lube, available from the factory, should be used for maximizing gasket life and ease of installation.

F. Joints shall be designed with a male and female overlapping metal-metal connection to maintain condensate on the AL29-4C stainless steel. Proper ¼” per foot pitch must be maintained at all times and condensate should flow back toward the appliance to the required number of drains

G. Vent shall be rated for an internal static pressure of 9” w.g.

H. All parts shall be compatible with other single wall and double wall products of the same manufacturer.

I. System is to be sized in accordance with the appliance manufacturer's specifications, NFPA 54-National Fuel Gas Code (ANSI Z223.1), ASHRAE recommendations and other applicable codes.

PART 3EXECUTION

A. Installation manuals shall be supplied to the installer.

B. All components shall be installed in strict compliance with the manufacturer’s instructions and all pertinent local, regional, and national building and mechanical codes and regulations.

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SECTION 23 52 39
CONDENSING FIRE-TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for heating hot water.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports: Indicate and interpret test results for compliance with performance requirements before shipping.

D. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

E. Warranty: Standard warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. AHRI Compliance: Boilers shall be AHRI listed and must meet the minimum efficiency specified under AHRI BTS-2000 as defined by Department of Energy in 10 CFR Part 431.

E. ANSI Compliance: Boilers shall be compliant with ANSI Z21.13 test standards for US and Canada.

F. CSA Compliant: Boilers shall be compliant with CSA certification.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

A. Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers:

a. Heat Exchanger, Pressure Vessel and Condensation Collection Basin shall carry a 10 year limited warranty against defects in materials or workmanship and failure due to thermal shock.

b. All other components shall carry a one year warranty from date of boiler start up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Lochinvar Crest Boiler as specified on Drawings. All others must be submitted by Voluntary alternate.

2.2 CONSTRUCTION

1. The **BOILER** shall be a **LOCHINVAR FTXL** Model **FTX N** having a modulating input rating of 399 Btu/Hr, an output of 387 Btu/Hr and shall be operated on Natural Gas Gas. The **BOILER** shall be capable of following performance:

2. Maximum unit dimensions shall be: 38-1/2 inches Length, 26-1/4 inches Width and 61-1/4 inches Height. Maximum operating (wet) unit weight shall be no more than 750 pounds.

3.

4. The **BOILER** shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The **BOILER** shall have a fully welded, stainless steel, fire tube heat exchanger. Multiple pressure vessels in a single enclosure

are not acceptable. There shall be no banding material, bolts, gaskets or "O" rings in the pressure vessel construction. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Pressure drop shall be no greater than 2.2 psi at 75 GPM. The condensate collection basin shall be constructed of welded stainless steel. The complete heat exchanger assembly shall carry a ten (10) year limited warranty.

5. The heat exchanger shall have a volume of water no less than: 13.2 gallons.

6. The **BOILER** shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada. The **BOILER** shall comply with the energy efficiency requirements of the latest edition of ASHRAE 90.1 and the minimum efficiency requirements of the latest edition of the AHRI BTS-2000 Standard as defined by the Department of Energy in 10 CFR Part 431. The **BOILER** shall operate at a minimum of 97% Combustion and Thermal Efficiency at full fire as registered with AHRI. The **BOILER** shall be certified for indoor installation.

7. The **BOILER** shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The **BOILER** (FTX1000 only) shall be supplied with an integrated air filter to filter the combustion air prior to entering the burner. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The **BOILER** shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The **BOILER** shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.

8. The **BOILER** shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The **BOILER** shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.

9. The **BOILER** shall feature the “SMART TOUCH™” control with CON-X-US which is standard and factory installed with an 7” liquid crystal touch screen display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities and PC port connection. A secondary operating control that is

field mounted outside or inside the appliance is not acceptable. The **BOILER** shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The **BOILER** shall have a built-in "Cascade" with leader redundancy to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal "Cascade" function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The **BOILER** shall be capable of controlling an isolation valve (offered by manufacturer) during heating operation and rotation of open valves in standby operation for full flow applications. The control must have optional capability to communicate via Modbus protocol with a minimum of 46 readable points. The **BOILER** shall have an optional gateway device which will allow integration with LON or BacNet protocols.

10. The "SMART TOUCH™" control shall include CON-X-US communication platform that will allow remote access via a smart phone or Tablet. This will allow the ability to monitor and manage multiple FTXL Boilers and send alerts via text or e-mail notifying of changes in system status. A user shall have the ability to check system status or re-program any boiler function remotely.

11. The "SMART TOUCH™" control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0-10 VDC output signal shall control a variable speed boiler pump (offered by manufacturer) to keep a fixed Delta T across the boiler regardless of the modulation rate. The **BOILER** shall have the capability to receive a 0-10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues such as erratic temperature cycling.

12. The **BOILER** shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 46 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump.

13. The **BOILER** shall be installed and vented with a (select one):

14. **(a) Direct Vent system with horizontal sidewall termination** of both the exhaust vent and combustion air. The flue shall be Category IV approved material constructed of PVC, CPVC, Polypropylene or Stainless Steel. A separate pipe shall supply combustion air directly to the boiler from the outside. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet.

15. The **BOILER** shall have an independent laboratory rating for Oxides of Nitrogen (NO_x) to meet the requirements of South Coast Air Quality Management District in Southern California and the requirements of Texas Commission on Environmental Quality. The manufacturer shall verify proper operation of the burner, all controls and the integrity of the heat exchanger by connection to water and venting for a factory fire test prior to shipping.

16. The **BOILER** shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments. The **BOILER** shall be certified for operation at elevations of 4,500 feet, and above, by a 3rd party organization.

17. The **BOILER** shall be suitable for use with polypropylene glycol up to a 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.

B. Safety Relief Valve:

1. Size and Capacity: 50 lb.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

C. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.

D. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.

E. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

2.3 CONTROLS

A. Refer to Division 23 Section "Instrumentation and Control for HVAC."

B. Boiler controls shall feature a standard, factory installed 8” LCD screen display with the following standard features:

1. Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger. The boiler shall be able to operate in this mode with a minimum temperature rise of 20 degrees F and a maximum temperature rise of 60 degrees F. Project specific temperature rise shall be 20 deg. F.
2. Password Security: Boiler shall have a different password security code for the User and the Installer to access adjustable parameters.
3. Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and an adjustable reset curve.
4. Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.

5. Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six time intervals.
6. Boost function: Boiler may be programmed to automatically increase the set point a fixed number of degrees (adjustable by installer) if the setpoint has been continuously active for a set period of time (time adjustable by installer). This process will continue until the space heating demand ends.
7. Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.
8. Service reminder: Boiler shall have the ability to display a yellow colored service notification screen based upon months of installation, hours of operation, and number of boiler cycles. All notifications are adjustable by the installer.
9. Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
10. Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.
11. Freeze protection: Boiler shall turn on the boiler and system pumps when the boiler water temperature falls below 45 degrees. When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.
12. Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
13. BACNET BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
14. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, hours running and ignition attempts and should be able to view on boiler screen.

C. The boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. The factory installed, internal cascade controller shall include:

1. Lead lag:
2. Efficiency optimization: The Control module shall allow multiple boilers to fire at minimum firing rate in lieu of Lead/Lag.
3. Front end loading:
4. Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.

D. Boiler operating controls shall include the following devices and features:

1. Set-Point Adjust: Set points shall be adjustable.
2. Operating Pressure Control: Factory wired and mounted to cycle burner.
3. Sequence of Operation: Factory installed controller to modulate burner firing rate to maintain system water temperature in response to call for heat.
4. Sequence of Operation: Electric, factory-fabricated and factory-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 10 deg F outside-air temperature, set supply-water temperature at 180 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.

E. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
5. Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
6. Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.
7. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.

F. Building Automation System Interface: Factory installed Modbus gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.

2.4 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring:

B. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

C. Electrical Characteristics:

1. See Drawings
2. Voltage
    a. 120V / 1PH Frequency: 60 Hz

2.5 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in of piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install equipment on 4” concrete housekeeping pad.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Install boilers level on concrete bases.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of equipment connection. Provide a reducer if required.

E. Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.

F. Install piping from safety relief valves to nearest floor drain.

G. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
2. Connect full size to boiler connections. Comply with requirements in Division 23 Section “Breechings, Chimneys, and Stacks.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions. Complete startup form included with Boiler and return to Manufacturer as described in the instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

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

D. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.
4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.

8. Perform a combustion analysis after installation and adjust gas valve per the Installation and Operations manual and note in startup report.
9. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory representative or a factory-authorized service representative for boiler startup and to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

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SECTION 23 64 00
PACKAGED WATER CHILLERS

PART 1: GENERAL

1.01 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for air-cooled scroll compressor chillers.

1.02 REFERENCES

A. Comply with applicable Standards/Codes of AHRI 550/590, ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by the State.

B. Units shall meet the efficiency standards of the current version of ASHRAE Standard 90.1, and FEMP standard 2012.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with the specifications.

B. Submittals shall include the following:

1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections
2. Summary of all auxiliary utility requirements such as electricity, water, etc. Summary shall indicate quality and quantity of each required utility.
3. Single line schematic drawing of the field power hookup requirements, indicating all items that are furnished.
4. Schematic diagram of control system indicating points for field interface/connection.
5. Diagram shall fully delineate field and factory wiring.
6. Installation and operating manuals.

1.04 QUALITY ASSURANCE

A. Qualifications: Equipment manufacturer must specialize in the manufacture of the products specified and have five years experience with the type of equipment and refrigerant offered.

B. Regulatory Requirements: Comply with the codes and standards specified.

C. Chiller manufacturer plant must be ISO Registered.

1.05 DELIVERY AND HANDLING

A. Chiller shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

B. Comply with the manufacturer's instructions for rigging and handling equipment.

1.06 WARRANTY

A. Standard Warranty (Domestic): The refrigeration equipment manufacturer's guarantee shall be for a period of one year from date of equipment start-up but not more than 18 months from shipment. The guarantee shall provide for repair or replacement due to failure by material and workmanship that prove defective within the above period, excluding refrigerant.

B. 1st Year Labor Warranty: None included

C. Extended Compressor Warranty: None.

D. Extended Unit Warranty: Entire unit, four (4) years parts only.

E. Refrigerant Warranty: None.

F. Delay Warranty Start: None.

1.07 MAINTENANCE

A. Maintenance of the chillers shall be the responsibility of the owner and performed in accordance with the manufacturer’s instructions.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Daikin Applied

B. (Approved Equal)

2.02 UNIT DESCRIPTION

A. Provide and install as shown on the plans factory-assembled, factory-charged air-cooled scroll compressor packaged chillers in the quantity specified. Each chiller shall consist of hermetic tandem scroll compressor sets, brazed plate evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

B. Chiller shall be functionally tested at the factory to ensure trouble free field operation

2.03 DESIGN REQUIREMENTS

A. Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

B. Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 15F to 65F.

C. General: Provide a complete scroll compressor packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

D. Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25%. Performance shall be in accordance with AHRI Standard 550/590.

E. Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

2.04 CHILLER COMPONENTS

A. Compressor

1. The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

B. Evaporator

1. The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates. Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor.

2. The evaporator shall be protected with an external, electric resistance heater plate. The evaporator and suction piping to the compressors shall be insulated with 3/4” (19 mm) thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage. The insulation shall have an additional outer protective layer of 3mm thick PE embossed film to provide superior damage resistance. Insulation without the protective outer film shall not be acceptable. UV resistance level shall meet or exceed a rating of ‘Good’ in accordance with the UNI ISO 4892 - 2/94 testing method. This combination of a heater plate and insulation shall provide freeze protection down to -20°F (-29°C) ambient air temperature.

3. The water-side maximum design pressure shall be rated at a minimum of 469 psig (3235 kPa). Evaporators shall be designed and constructed according to, and listed by, Underwriters Laboratories (UL).

C. Condenser

1. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.

2. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils shall withstand 1000+ hour acidified synthetic sea water fog (SWAAT) test (ASTM G85-02) at 120°F (49°C) with 0% fin loss and develop no leaks.

D. Refrigerant Circuit

1. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

E. Construction

1. Unit formed sheet metal components shall be painted using a corrosion resistant paint system, for aesthetics and long-term durability. Paint system will include a base primer with a high-quality polyester resin topcoat. Painted galvanized parts shall be G60 or greater and finished, unabraded panel surfaces shall be capable to be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16” at 1,000 hours minimum exposure to an ASTM B117 salt spray environment.

2. Upper section of unit shall have protective and decorative louvers covering the coils and unit end; base section of unit shall have protective, 12 GA, PVC-coated, wire grille guards and have painted steel wraps enclosing the coil end sections and piping.

F. Control System

1. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

2. Shall include high short circuit current rating of 65,000 amps with single-point disconnect switch

G. Unit Controller

1. An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:
2. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.
3. Shutdown Alarms
    a. No evaporator water flow (auto-restart)
    b. Sensor failures
    c. Low evaporator pressure
    d. Evaporator freeze protection
    e. High condenser pressure
    f. Outside ambient temperature (auto-restart)
    g. Motor protection system
    h. Phase voltage protection (Optional)
4. Limit Alarms
    a. Condenser pressure stage down, unloads unit at high discharge pressures.
    b. Low ambient lockout, shuts off unit at low ambient temperatures.
    c. Low evaporator pressure hold, holds stage #1 until pressure rises.
    d. Low evaporator pressure unload, shuts off one compressor.
5. Unit Enable Section
    a. Enables unit operation from either local keypad, digital input, or BAS
6. Unit Mode Selection
    a. Selects standard cooling, ice, glycol, or test operation mode
7. Analog Inputs:
    a. Reset of leaving water temperature, 4-20 mA\
    b. Current Limit
8. Digital Inputs
    a. Unit off switch
    b. Remote start/stop
    c. Flow switch
    d. Ice mode switch, converts operation and setpoints for ice production
    e. Motor protection
9. Digital Outputs
    a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
    b. Evaporator pump; field wired, starts pump when unit is set to start

10. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

11. Building Automation System (BAS) Interface

a. Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.

b. BACnet MS/TP master (Clause 9)

c. BACnet IP, (Annex J)

d. BACnet ISO 8802-3, (Ethernet)

e. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

f. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.05 OPTIONS AND ACCESSORIES

A. The following options are to be included:

1. Rapid Restore™: The chiller shall be equipped with the capability to restart and to reach full load more quickly than standard in case of a power interruption. The chiller shall be capable of rapidly restarting after power loss duration of up to 180 seconds. The time to restart the chiller shall be a maximum of 125 seconds, and full load shall be achieved in 220 seconds from power restoration. Fast Loading Stand-By Chiller: The chiller shall be equipped with the capability to start and to reach full load more quickly than standard in the event that the primary chiller system is disabled. The chiller shall be capable of rapidly achieving full capacity. The time to full load shall be achieved in 115 seconds.

2. Low Ambient Control: Fan VFD allows unit operation from 32°F down to -4°F (-23.3 C).

3. Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.

4. BAS interface module to provide interface with a combination of BACnet IP, BACnet MSTP, and Modbus protocols.

5. Compressor Sound Reduction - Acoustic reduction blankets shall be factory installed on each compressor.

6. The following accessories, if selected, are to be included:

a. Spring vibration isolators for field installation
b. Rubber-in-shear vibration isolators for field installation
c. Factory-mounted thermal dispersion type flow switch
d. Field-mounted, paddle type, chilled water flow switch field wired to the control panel
e. Wye strainer, to be installed at the evaporator inlet and sized for the design flow rate , with perforation diameter of 0.063" with blowdown valve and Victaulic couplings (factory mounted or field installed)
f. 115V GFI convenience outlet

B. Optional Factory-Installed Pump Package: None

PART 3: EXECUTION

3.01 INSTALLATION

A. Install in strict accordance with manufacturer's requirements, shop drawings, and contract documents.

B. Adjust and level chiller in alignment on supports.

C. Coordinate electrical installation with electrical contractor.

D. Coordinate controls with control contractor.

E. Install a field-supplied or optional manufacturer-supplied strainer in the chilled water return line at the evaporator inlet that meets manufacturer perforation size specifications.

3.02 START-UP

A. Provide testing and starting of machine, and instruct the Owner in its proper operation and maintenance.

- - - E N D - - -

SECTION 23 81 00
DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies split-systems.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions:

1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
3. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
4. Where such equipment is provided in greater than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

E. Section 23 23 00, REFRIGERANT PIPING.

1.3 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT”, with applicable paragraph identification.

C. Manufacturer’s literature and data Including:

1. Sufficient information, including capacities, pressure drops, and piping connections clearly presented, shall be included to determine compliance with contract documents for units noted below:

a. Unitary air conditioners:

1) Split systems

2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.

3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.

4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.

D. Certification: Submit proof of specified ARI Certification.

E. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, integrated energy efficiency ratio (IEER), and coefficient of performance (COP).

F. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to COR three weeks prior to final inspection.

G. Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.4 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

1.5 **AS-BUILT DOCUMENTATION**

A. Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 **SPLIT-SYSTEM AIR CONDITIONERS**

A. Description: Factory assembled and tested, wall-mounted unit, with an air- cooled remote condensing unit, and field-installed refrigeration piping.

B. Concealed Evaporator Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

2. Insulation: Factory-applied duct liner.

3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.

4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.

8. Disposable Filters: 25 mm (1 inch) thick, in fiberboard frames // with MERV rating of 7 or higher according to ASHRAE 52.2//.
9. Wiring Terminations: Connect motor to chassis wiring with plug connection.

C. Wall-Mounting, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
5. Fan: Direct drive, centrifugal fan.
6. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
7. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

D. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves, fittings, and gauge ports shall be brass and located outside of the casing.
2. Compressor: Hermetically sealed // variable speed // reciprocating // scroll // with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
5. Fan: Aluminum, propeller type, directly connected to motor.
6. Motor: Permanently lubricated, with integral thermal-overload protection.

7. Low Ambient Kit: Permit operation down to minus 18 degrees C (0 degrees F).
8. Mounting Base: Polyethylene.
9. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Rooftop Unit Support: Install unit level on structural pilings. Coordinate wall penetrations and flashing with wall construction. Secure rooftop units to structural support with anchor bolts.
B. Install units level and plumb maintaining manufacturer’s recommended clearances and tolerances.
C. Install roof-mounting compressor-condenser components on equipment supports specified in Section 07 72 00, ROOF ACCESSORIES. Anchor units to supports with removable, cadmium-plated fasteners.
D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
E. Install wall sleeves in finished wall assembly and weatherproof. Install and anchor wall sleeves to withstand, without damage seismic forces as required by code.

3.2 CONNECTIONS

A. Verify condensate drainage requirements.
B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
C. Install piping adjacent to units to allow service and maintenance.
D. Ground equipment and install power wiring, switches, and controls for self-contained and split systems.
E. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP AND TESTING

A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct owner's personnel in operation and maintenance of units.

---END---

SECTION 23 82 00
CONVECTION HEATING AND COOLING UNITS

PART 1 – GENERAL

1.01 Section Includes

A. High Performance Horizontal Fan Coil Units.

1.02 Related Requirements

A. Section 01 40 00 - Quality Requirements
B. Section 01 74 19 - Construction Waste Management and Disposal
C. Section 01 78 00 - Closeout Submittals
D. Section 01 79 00 - Demonstration and Training
E. Section 23 09 93 - Sequence of Operations for HVAC Controls.
F. Section 23 21 13 - Hydronic Piping: Connections to heating coils.
G. Section 23 21 14 - Hydronic Specialties: Connections to heating coils.
H. Section 23 31 00 - HVAC Ducts and Casings.
I. Section 23 33 00 - Air Duct Accessories.
J. Section 23 37 00 - Air Outlets and Inlets.
K. Section 23 82 00 - Convection Heating and Cooling Units: Air coils.
L. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 Reference Standards

All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.

AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.

AHRI 440 - Standard for Performance Rating of Room Fan-Coils.

M. AHRI 880 - Standard for Performance Rating of Air Terminals.
N. AHRI 885 - Standard Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
O. ASHRAE 62.1 - Standard for Ventilation for Acceptable Indoor Air Quality.
P. ASHRAE 130 - Standard for Laboratory Methods of Testing Air Terminal Units
Q. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
S. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
T. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
U. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

V. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.

1.04 Administrative Requirements

A. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section, and require attendance by all affected installers.

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

1.05 Submittals

A. Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate airflow, static pressure, NC designation, electrical characteristics, and connection requirements.

B. Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

C. Manufacturer shall include schedules listing discharge and radiated sound power level for each of second through seventh octave bands at inlet static pressures from 1 to 3 inch water gauge.

D. Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.

E. Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.

F. Project Record Documents shall record actual locations of units and controls components and locations of access doors.

G. Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

H. Manufacturer’s warranty shall be submitted and ensure forms have been completed in Owner's name and registered with manufacturer.

I. Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.

1.06 Quality Assurance

A. Manufacturer Qualifications shall be specified in this section, with minimum ten years of documented experience.

B. Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and be acceptable to authorities having jurisdiction.

1.07 Warranty

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Provide 18 month manufacturer warranty from date of shipment for air fan coil units, integral sound attenuators, integral heating coils, and integral controls.

PART 2 – PRODUCTS

2.01 General

A. Basis of Design: Price Industries, Inc.
   1. High Performance, Plenum, Horizontal Fan Coil Unit: FHPP.

B. Performance Requirements:
   1. Units shall have published sound power level data per AHRI 260 or AHRI 350 depending on production configuration.
   2. Unit shall be performance certified with the latest edition of AHRI 440.
   1. Units shall be ETL listed in compliance with UL/ANSI 1995

2.02 High Performance, Plenum, Horizontal Fan Coil Units

A. General:
   1. Furnish and install Price FHPP Fan Coil Units where indicated on the plans and in the specifications.
   2. Units shall be completely factory assembled, tested and shipped as a single piece.
   3. All units shall be capable of meeting or exceeding the scheduled capacities for cooling, heating and air delivery.
   4. All unit dimensions for each model and size shall be considered maximums.

B. Construction:
   1. Unit Casing
      a. The unit casing shall be fabricated of 18-gauge galvanized steel panels
      b. Units with a rear return shall have a bottom access panel to allow removal of the fan and servicing of the unit.
      c. Units with a bottom return shall have a rear access panel to allow removal of the fan and servicing of the unit.
      d. All exterior panels shall be insulated with 1/2 inch thick insulation.
   2. Discharge Collar:
      a. All units shall have a slip and drive duct collar connection on the discharge.
      b. All units shall have a minimum one inch duct collar on the discharge.
   3. Liners:

a. Standard:
    1. Fiber Free Foam Liner – FF
        a. Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84 and NFPA 90A. The insulation shall comply with Antimicrobial Performance Rating of zero with no observed growth, per UL181.
        b. The insulation shall be secured with adhesive.
        c. Insulation edges exposed to the airstream shall be coated with NFPA approved sealant.

4. Unit Mounting:
    a. The unit shall be mounted with the use of:
        1. Spring isolators: The manufacturer shall supply spring isolators and hanger brackets, shipped loose for field installation with threaded hanger rods supplied by others. The spring isolators shall be rated according to the weight of the fan coil unit and oriented according to the manufacturer's instructions to properly damper the fan coil.
5. Blower:
    a. The blower shall be a dynamically balanced, forward curved, double width/double inlet (DWDI) centrifugal type, constructed of zinc coated galvanized steel for corrosion resistance.
6. Motor:
    a. The unit shall be supplied with an electronically commutated motor (ECM), complete with a single phase integrated controller/inverter that operates the wound stator and senses motor position to electronically commutate the stator.
    b. The motor rotor shall be permanent magnet type with near zero rotor losses.
    c. The motor shall be permanently lubricated with ball bearings, maintaining a minimum of 70% efficiency over its entire operating range.
    d. The motor shall be supplied complete with a manual fan speed controller for field adjustment of fan air flow set-point.
    e. The speed controller shall accept as standard a [0-10VDC], or [4-20mA] signal for remote fan adjustment from a building automation system.
    f. The ECM shall be furnished with factory programming:
        1. High Turndown Flow Program

a. A modulating high turndown flow program shall be provided to allow the ECM to operate with constant torque to vary the airflow with fluctuations in external static pressure
b. The motor shall be supplied complete with a manual fan speed controller for field adjustment of fan air flow set-point.
c. The speed controller shall accept as standard a [0-10 VDC], or [0-20 mA] signal for remote fan adjustment from a building automation system.

7. Drain Pans:
   a. All units shall be supplied with a primary drain pan with single wall, galvanized steel for corrosion resistance.
   b. The primary drain pan shall extend under the entire cooling coil
   c. Drain pans shall be of one-piece construction and be positively sloped for condensate removal.
   d. Drain pans shall be externally insulated with fire retardant foam insulation. The insulation shall carry no more than a 25/50 Flame Spread and Smoke Developed Rating per ASTM E84 and UL 723 and an Antimicrobial Performance Rating of zero with no observed growth per UL 181.
8. Filters:
   a. All units shall be furnished with a minimum two inch thick nominal pleated filter.
   b. The filter shall have a Minimum Efficiency Reporting Value (MERV) of MERV8.
9. Electrical:
   a. Units shall be furnished with single point power connection.
   b. Units shall be furnished with a NEMA 250, Type 1 electrical enclosure.
10. Unit Options:
    a. Water Cooling and Heating Coils:
       1. All water coils shall be rated and certified in accordance with the current edition of AHRI 410, and shall bear the AHRI seal on the unit casing.
       2. All cooling and heating coils shall optimize rows and fins per inch to meet the specified capacity.
       3. Coils shall have seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and fin.
       4. Fins shall have a high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.
       5. All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per

square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.

6. Cooling and heating coils shall be in separate coil casings.
7. Units with cooling coils shall be supplied with an integral condensate diverting section to prevent condensate carry over.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the owner, the contractor shall correct the installation at no additional cost or time to the owner.

B. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

C. Handle and install units in accordance with manufacturer's written instructions.

D. Support units rigidly so they always remain stationary. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

E. Install fiberglass blanket insulation with a minimum R value of 8 above hydronic radiant panels.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the owner.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for 4 hours to instruct each owner’s personnel responsible in operation and maintenance of the system.

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SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. The following specification details the work and related criteria for a complete electrical system.
   2. Subcontractor shall furnish services, materials, labor, and equipment for the complete installation of lighting & control systems in accordance with these Specifications and the accompanying Drawings.

1.02 REFERENCES

A. General
   1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
   2. Unless otherwise noted, the edition of the referenced code or standard that is current at the time of the “date of record” for the Work shall be considered the effective code or standard for the duration of the project.
   3. Refer to specific Division 26 Sections for additional referenced codes and standards.

B. Execute and inspect all work in full accordance with the latest applicable rules, regulations, requirements, and specifications of the following.
   1. ANSI/NFPA 70 – National Electric Code (NEC), most recent addition adopted by Authority Having Jurisdiction, including all applicable amendments and supplements.
   2. NFPA – National Fire Protection Association: Standard for Electrical Safety in the Workplace (NFPA 70E).
   3. NECA 1 – National Electrical Contractors Association (NECA) Standard of Installation.
   4. National Electrical Manufacturers Association (NEMA)
   5. American National Standards Institute (ANSI).
   6. National Electrical Safety Code (NESC).
   7. Underwriters Laboratories (UL)
   8. Illuminating Engineering Society of North America (IES).

1.03 SUBMITTALS

A. Provide complete manufacturer’s data sheets, product literature and shop drawings for all equipment, material and devices furnished under Division 26 – Electrical, demonstrating compliance with these Specifications and accompanying Drawings.

B. Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and nonapplicable portions deleted or crossed out.

1.04 QUALITY ASSURANCE

A. If the Drawings or Specifications do not appear clear or definite, the Subcontractor shall request from the Project Manager through the ‘Request for Information’ (RFI) process an interpretation and decision of same, and shall have such questions decided before proceeding with the Work.

B. Manufacturer's Directions: Follow manufacturer's directions covering points not shown on the drawings or specified herein. Manufacturer's directions do not take precedence over Drawings and Specifications. Where these conflict with the Drawings and Specifications, notify the Project Manager for clarification before installing the work.

C. Protection of Equipment:
   1. Care shall be exercised during construction to avoid damage or disfigurement. Equipment shall be protected from dust and moisture prior to and during construction. The

Subcontractor is cautioned that concrete finishing, painting, etc., in electrical rooms shall not proceed if unprotected equipment is installed.

2. Where required or directed, construct temporary protection for equipment and installations to protect same from dust and debris caused by construction.

D. Materials and Equipment:
   1. Materials and equipment shall be new. Materials and equipment for which tests have been established by Underwriter's Laboratories, Inc. shall be approved by that body and shall bear its label of approval or the label of an OSHA approved nationally recognized testing laboratory (NRTL).
   2. Unless otherwise approved by the Project Manager, the materials to be furnished under this Specification shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to material specified, and shall be the manufacturer's latest standard design that complies with the Specification requirements.

E. Approval of Materials:
   1. A complete list of materials and equipment proposed shall be submitted to the Project Manager for approval. The list shall include for each item: the manufacturer, the manufacturer's catalog number, type or class, the rating, capacity, size, NRTL label/listing, etc.
   2. The Subcontractor shall submit a brochure containing catalog cuts or drawings and data for, but not limited to, the following items:
      a. Before installation of the equipment, the Subcontractor shall submit for approval detailed construction drawings for each item of fabricated equipment required for the electrical installation. Drawings shall be to scale and fully dimensioned and shall provide sufficient detail to clearly indicate the arrangement of equipment, including its components, and conduit/raceway system routing and configuration.
      b. Installation of approved substituted equipment is the Subcontractor's responsibility, and changes required to work included under other divisions for installations of approved substituted equipment must be made to the satisfaction of the Architect/Engineer and without change in Subcontract price.

1.05 COORDINATION

A. Coordinate schedules, access to MSU facilities, material supply, and all construction related processes through R&R Taylor.

1.06 RECORD DRAWINGS

A. As-built Drawings shall be prepared by the Contractor to show departures from original Drawings and to indicate installed conditions for:
   1. Major raceway systems, size, and location, for both exterior and interior; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
   2. All hidden equipment requiring future maintenance or replacement, such as power packs, mini-inverters, etc, must be documented within Record Drawings by Installer, per Montana State University Engineering Guidelines.
   3. Approved substitutions and actual equipment and materials installed.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project identified with names, model numbers, types, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area that meets ambient and storage temperatures per manufacturer product literature.
   1. Major raceway systems, size, and location, for both exterior and interior; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
   2. Equipment locations (exposed and concealed), dimensioned from established building lines.
   3. Approved substitutions and actual equipment and materials installed.

1.08 WARRANTY

A. Provide complete warranty information for each item, including start date of warranty and duration of warranty.

B. See individual specification sections within this document.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT REQUIREMENTS

A. General
   1. All materials provided shall be new and free of defects, and suitable for the space provided.
   2. Equipment of the same type shall be of the same manufacturer.
   3. Provide materials and equipment listed for the intended purpose by Underwriters (UL) or an equivalent testing firm and bearing its label of approval.
   4. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment.

B. Hazardous Areas
   1. Provide materials and equipment acceptable to the regulatory AHJ for the Class, Division and Group of hazardous area indicated.

PART 3 – EXECUTION

3.01 ELECTRICAL INSTALLATIONS

A. General
   1. General work practices for electrical construction shall be in accordance with NECA 1 Standard of Installation for good workmanship.
   2. Coordinate electrical systems, equipment and materials installation with General Contractor and work of other trades to mitigate conflicts, errors, and delays during construction.
   3. Drawings are diagrammatic and indicate general arrangement. Check the approximate locations electrical system components shown on Drawings for conflicts with components of other systems and equipment. Headroom and space condition to be maintained.
   4. Drawings and accompanying specifications are intended to describe and illustrate systems which will not interfere with the structure of the building and which will fit into the available spaces. Install electrical equipment to conform to NEC clearances and to avoid obstructions with architectural, structural, mechanical and site conditions.

B. Layout and Coordination
   1. Layout of the various equipment is specific with the relative location shown on the drawings. Call attention to any error, conflict, or discrepancy in the drawings or specifications. Do not proceed with any questionable items of work until clarification has been received.
   2. Verify the physical dimensions of each item of electrical equipment and required clearances to fit the available space and provide prompt notification prior to roughing-in if conflicts appear. Coordinate equipment to fit into the available spaces and coordinate access routes through the construction site.

3.02 PROTECTION

A. Electrical work, wire and cable, materials, and other equipment specified in this division shall be protected against damage by other construction activities, weather conditions, or any other causes as a part of this work. Equipment found damaged or in other than new condition shall be rejected as defective.

B. Conduit and raceways shall be kept closed during construction to prevent entrance of dirt, moisture, concrete, or foreign objects. Raceways shall be clean and dry before installation of wire and shall be so at the time of acceptance.

3.03 EQUIPMENT IDENTIFICATION

A. Distribution Equipment: Distribution equipment shall be identified by circuit number, voltage, phase, and wire as shown on drawings or specified elsewhere in these Specifications.

B. Schedules: Panelboards shall be furnished with a complete 8-1/2" x 11" typewritten schedule mounted on the inside of the inner door. If field changes are necessary, new schedules shall be provided by the Subcontractor.

C. Equipment: Properly identify circuit breakers and other devices on switchboards, motor disconnect switches, starters, time clocks, and other apparatus used for operation of, or control of circuits, appliances or equipment by means of 3/32-inch thick black laminated phenolic nameplate with white core. For switchboards and panelboards, fed by standby or emergency power sources, use 3/32-inch thick yellow laminated phenolic nameplate with black core.

END OF SECTION 26 0500

SECTION 26 0505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation, circuit tracing, and architectural drawings..

D. Report discrepancies to Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, contact MSU to ensure existing tests will not be disturbed in such operations.

C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify MSU before partially or completely disabling system.
   2. Make notifications at least 24 hours in advance.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.
   3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply or final device still connected to circuit.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION 26 0505

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Power and control tray cable.

D. Wiring connectors.

E. Electrical tape.

F. Wire pulling lubricant.

G. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 28 4600 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

G. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

L. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

M. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

N. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

P. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

H. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:

1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.

I. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
a. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.
b. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. Southwire Company: www.southwire.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.04 METAL-CLAD CABLE

A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Service Wire Co: www.servicewire.com/#sle.
4. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Grounding: Full-size integral equipment grounding conductor.

G. Armor: Steel, interlocked tape.

2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

2.06 ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
   2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
   3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).

B. Wire Pulling Lubricant:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. American Polywater Corporation: www.polywater.com/#sle.
      c. Ideal Industries, Inc: www.idealindustries.com/#sle.
   2. Listed and labeled as complying with UL 267.
   3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
   4. Suitable for use at installation temperature.

C. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

G. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

H. Install conductors with a minimum of 12 inches (300 mm) of slack at each device.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

K. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

M. Insulate ends of spare conductors using vinyl insulating electrical tape.

N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

O. Identify conductors and cables in accordance with Section 26 0553.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using listed materials and methods..

Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 0519

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
   1. Use insulated copper conductors unless otherwise indicated.

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Perform work in accordance with NECA 1 (general workmanship).

C. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 0553.

END OF SECTION 26 0526

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

B. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
   2. Coordinate work to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
   4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
   5. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.
   2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
   3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.

4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Components for Vibration Isolation and/or Seismic Controls: See Section 26 0548.

C. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

E. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.

F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    a. Outlet Boxes: 1/4-inch (6 mm) diameter.

G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.

E. Do not penetrate or otherwise notch or cut structural members.

F. Equipment Support and Attachment:
1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

G. Box Support and Attachment: See Section 26 0533.16 for additional requirements.

H. Secure fasteners in accordance with manufacturer's recommended torque settings.

I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 0529

SECTION 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Stainless steel rigid metal conduit (RMC).

C. Galvanized steel intermediate metal conduit (IMC).

D. Stainless steel intermediate metal conduit (IMC).

E. Flexible metal conduit (FMC).

F. Liquidtight flexible metal conduit (LFMC).

G. Galvanized steel electrical metallic tubing (EMT).

H. Stainless steel electrical metallic tubing (EMT).

I. Aluminum electrical metallic tubing (EMT).

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

E. Section 26 0533.16 - Boxes for Electrical Systems.

F. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.

F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

I. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

J. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

K. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

L. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

M. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

N. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.

O. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

P. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
   4. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

D. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

E. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

F. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

G. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
   1. Maximum Length: 6 feet (1.8 m).

H. Flexible Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit (FMC).
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
   3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.

4. Vibrating equipment includes, but is not limited to:
   a. Motors.

I. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
   1. Where permitted, existing conduits to be reused may be used as sole equipment grounding conductor only when continuity of conduit pathway, including associated boxes and fittings, is verified; see Section 26 0526.

C. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.

D. Provide conduit, fittings, supports, and accessories required for complete raceway system.

E. Provide products listed, classified, and labeled as suitable for purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 3/4-inch (21 mm) trade size.
   2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
   3. Control Circuits: 1/2-inch (16 mm) trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
   1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.

B. Fittings:
   1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
   2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:
   1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.06 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:
   1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

2.09 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use compression/gland or set-screw type.
      a. Do not use indenter type connectors and couplings.

2.10 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Connectors and Couplings: Use compression/gland or set-screw type.

2.11 ALUMINUM ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT aluminum electrical metallic tubing listed and labeled as complying with UL 797A.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; listed for use with aluminum EMT.
   2. Material: Use aluminum.
   3. Connectors and Couplings: Use compression/gland or set-screw type.
      a. Do not use indenter type connectors and couplings.

2.12 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

B. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf (5.6 kN).

C. Conduit Mechanical Seals:
   1. Listed as complying with UL 514B.
   2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
   3. Suitable for sealing around conductors/cables to be installed.

D. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Install conduit in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Arrange conduit to maintain adequate headroom, clearances, and access.
   6. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
   7. Arrange conduit to provide no more than 150 feet (46 m) between pull points.

F. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
   2. Provide required vibration isolation and/or seismic controls; see Section 26 0548.
   3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   5. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   6. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   8. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
   9. Use of wire for support of conduits is not permitted.

G. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
7. Install firestopping to preserve fire resistance rating of partitions and other elements.

I. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

J. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
   a. Where conduits enter building from outside.
   b. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

K. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.

L. Provide grounding and bonding; see Section 26 0526.

M. Identify conduits; see Section 26 0553.

3.02 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Correct deficiencies and replace damaged or defective conduits.

3.03 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.04 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 0533.13

SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.

D. Section 26 0533.23 - Surface Raceways for Electrical Systems:

E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 26 2726 - Wiring Devices:

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   2. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   3. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use suitable concrete type boxes where flush-mounted in concrete.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.
   5. Use raised covers suitable for the type of wall construction and device configuration where required.
   6. Use shallow boxes where required by the type of wall construction.
   7. Do not use "through-wall" boxes designed for access from both sides of wall.
   8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   10. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   11. Wall Plates: Existing to remain. Match existing as needed.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
   3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Box Locations:
   1. Locate boxes to be accessible.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes so that wall plates do not span different building finishes.
   4. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   5. Locate junction and pull boxes in the following areas:
      a. Concealed above accessible suspended ceilings.
      b. Within joists in areas with no ceiling.
      c. Electrical rooms.
      d. Mechanical equipment rooms.

G. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide required seismic controls in accordance with Section 26 0548.
   3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
   4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

H. Install boxes plumb and level.

I. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
   2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
   3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.

J. Install boxes as required to preserve insulation integrity.

K. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

L. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

M. Close unused box openings.

N. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

O. Provide grounding and bonding in accordance with Section 26 0526.

P. Identify boxes in accordance with Section 26 0553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 0533.16

SECTION 26 0548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.

C. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.

F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.

G. MFMA-4 - Metal Framing Standards Publication; 2004.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   3. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
      b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
   4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
   3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
   4. Select vibration isolators for outdoor equipment to comply with wind design requirements.

D. Equipment Isolation:
   1. Engine Generators:
      a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
      b. Nonseismic Applications, Isolators Not Located Below Sub-Base Fuel Tank: Use housed spring isolators or restrained spring isolators.
      c. Nonseismic Applications, Isolators Located Below Sub-Base Fuel Tank: Use restrained spring isolators.
      d. Seismic Applications: Use seismic type restrained spring isolators.
      e. Minimum Static Deflection:
         1) Generators Mounted on Grade-Level Slabs: 1 inch (25 mm) deflection unless otherwise indicated.

E. Conduit Isolation:
   1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Component Importance Factor (Ip): Electrical components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.

B. Component Importance Factor (Ip): Electrical components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
   1. Electrical components required to function for life safety purposes after an earthquake.

C. Seismic Restraints:
   1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
   2. Seismic Restraint Exemptions:
      a. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
         1) Raceways with component importance factor (Ip) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
            (a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting

structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.

(b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds (890 N) or less.

(c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.

(d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds (220 N) or less.

2) Conduits less than 2-1/2 inch (64 mm) trade size.

3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
   a. ASHRAE (HVACA).
   b. FEMA 413.
   c. FEMA E-74.
   d. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
   c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
   e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
   f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
   g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
   i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

D. Seismic Attachments:
   1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.

2.03 SEISMIC RESTRAINT SYSTEMS

A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

B. Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

C. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Secure fasteners according to manufacturer's recommended torque settings.

E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Seismic Controls:
1. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
2. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
3. Equipment with Sheet Metal Housings:
   a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
   b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
   c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.

4. Seismic Restraint Systems:
    a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    b. Install restraints within permissible angles in accordance with seismic design.
    c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.03 FIELD QUALITY CONTROL

A. Inspect vibration isolation and/or seismic control components for damage and defects.

B. Vibration Isolation Systems:
    1. Verify isolator static deflections.
    2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 26 0548

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

B. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Raceways:
   1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet (6.1 m).
   2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.

D. Identification for Boxes:
   1. Use voltage markers to identify highest voltage present.
   2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

E. Identification for Devices:
   1. Use identification label or engraved wallplate to identify serving branch circuit for all lighting control devices.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Labels:
   1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

B. Format for Equipment Identification:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
2. Legend:
a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
a. Equipment Designation: 1/2 inch (13 mm).
5. Color:
a. Normal Power System: <> .
1) 208Y/120 V, 3 Phase Equipment: White text on black background.
b. Emergency Power System: White text on red background.
c. Fire Alarm System: White text on red background.

C. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Black text on clear background.

2.03 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

C. Minimum Size:
1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
3. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).

D. Legend:
1. Markers for Voltage Identification: Highest voltage present.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

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

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Interior Components: Legible from the point of access.
6. Conduits: Legible from the floor.
7. Boxes: Outside face of cover.
8. Conductors and Cables: Legible from the point of access.
9. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

E. Mark all handwritten text, where permitted, to be neat and legible. Otherwise, provide computer generated text.

END OF SECTION 26 0553

SECTION 26 0573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

B. Section 26 2416 - Panelboards.

1.03 REFERENCE STANDARDS

A. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

B. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).

C. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.

D. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.

E. NEMA MG 00001 - Motors and Generators; 2024.

F. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
   2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Engineer.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Study reports, stamped or sealed and signed by study preparer.

C. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
   1. Identify modifications made in accordance with studies that:
      a. Can be made at no additional cost to Owner.

b. As submitted will involve a change to the contract sum.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
1. Perform analysis of new panels as indicated on drawings.
2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
a. Known Operating Modes:
1) Utility as source.
2) Generator as source.

B. General Study Requirements:
1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
1) Obtain up-to-date information from Utility Company.
b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
d. Protective Devices:
1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
e. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
a. Maximum utility fault currents.
b. Maximum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Study Reports:
1. General Requirements:
a. Identify date of study and study preparer.
b. Identify study methodology and software product(s) used.
c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
d. Identify base used for per unit values.
e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
f. Include conclusions and recommendations.

2. Short-Circuit Study:
    a. For each scenario, identify at each bus location:
        1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
        2) Fault point X/R ratio.
        3) Associated equipment short circuit current ratings.
    b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.

B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
    1. Products:
        a. EasyPower LLC: www.easypower.com/#sle.
        b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
        c. Power Analytics Corporation: www.poweranalytics.com/#sle.
        d. SKM Systems Analysis, Inc: www.skm.com/#sle.

END OF SECTION 26 0573

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.

G. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

D. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

M. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

N. Load centers are not acceptable.

O. Provide the following features and accessories where indicated or where required to complete installation:
   1. Feed-through lugs.
   2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase and Neutral Bus Material: Copper.
   2. Ground Bus Material: Copper.

D. Circuit Breakers:
   1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.

E. Enclosures:
   1. Provide surface-mounted enclosures unless otherwise indicated.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Copper.
   3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
         1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.

b. Lug Material: Copper, suitable for terminating copper conductors only.

4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide interchangeable trip units for circuit breaker frame sizes 200 amperes and larger.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.
10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Provide required seismic controls in accordance with Section 26 0548.

G. Install panelboards plumb.

H. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

I. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

J. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

K. Provide grounding and bonding in accordance with Section 26 0526.

L. Install all field-installed branch devices, components, and accessories.

M. Provide filler plates to cover unused spaces in panelboards.

N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Communications equipment circuits.

O. Identify panelboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Test GFCI circuit breakers to verify proper operation.

F. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Receptacles.

B. Wall plates and covers.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

D. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

E. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   4. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.

D. Provide GFCI protection for receptacles installed in kitchens.

E. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: Match existing.

2.03 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

B. Convenience Receptacles:
   1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

C. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
      a. Provide test and reset buttons of same color as device.
   2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

2.04 WALL PLATES AND COVERS

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

K. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

L. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

M. Identify wiring devices in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.04 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 2726

SECTION 26 3213
ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:
   1. Engine and engine accessory equipment.
   2. Alternator (generator).
   3. Generator set control system.
   4. Generator set enclosure.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 23 1113 - Facility Fuel-Oil Piping:
   1. Diesel fuel piping.

C. Section 23 5100 - Breechings, Chimneys, and Stacks: Engine exhaust piping.

D. Section 26 0526 - Grounding and Bonding for Electrical Systems.

E. Section 26 0529 - Hangers and Supports for Electrical Systems.

F. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

H. Section 26 3600 - Transfer Switches.

1.03 REFERENCE STANDARDS

A. ASTM D975 - Standard Specification for Diesel Fuel; 2024a.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.

D. NEMA MG 00001 - Motors and Generators; 2024.

E. NFPA 30 - Flammable and Combustible Liquids Code; 2024, with Errata (2025).

F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2024, with Amendment.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 99 - Health Care Facilities Code; 2021, with Amendment.

I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.

J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.

K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.

L. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
   1. Include generator set sound level test data.

2. Include characteristic trip curves for overcurrent protective devices upon request.
3. Include alternator thermal damage curve upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
1. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

F. Source quality control test reports.

G. Manufacturer’s detailed field testing procedures.

H. Field quality control test reports.

I. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A. Comply with the following:
1. NFPA 70 (National Electrical Code).
2. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
3. NFPA 30 (Flammable and Combustible Liquids Code).

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Packaged Engine Generator Set:
1. Caterpillar Inc: www.cat.com/#sle.
2. Cummins Power Generation Inc: www.cumminspower.com/#sle.
3. Rolls-Royce Power Systems; MTU: www.mtu-solutions.com/#sle.

B. Source Limitations: Furnish engine generator sets and associated components and accessories produced by single manufacturer and obtained from single supplier.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:
   1. Application: Emergency/standby.
   2. Configuration: Single packaged engine generator set operated independently (not in parallel).
   3. Total System Power Rating: As indicated on drawings, <>.

D. Packaged Engine Generator Set:
   1. Type: Diesel (compression ignition).
   2. Power Rating: As indicated on drawings, <>.
   3. Voltage: As indicated on drawings.
   4. Main Line Circuit Breaker:
      a. Type: Electronic trip with long time and short time delay and instantaneous pickup.
      b. Trip Rating: Select according to generator set rating.
      c. Features:
         1) Shunt trip.

E. Generator Set General Requirements:
   1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
   2. Factory-assembled, with components mounted on suitable base.
   3. List and label engine generator assembly as complying with UL 2200.
   4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
   5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
   6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

F. Seismic Qualification: Provide engine generator assemblies and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

G. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

H. Starting and Load Acceptance Requirements:
   1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
   2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
   3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).

I. Exhaust Emissions Requirements:
   1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
   2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Diesel (Compression Ignition):
   1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.
   2. Fuel Storage: Sub-base fuel tank. Match existing.
   3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
   4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
   5. Sub-Base Fuel Tank:
      a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
      b. Tank Capacity: Size for minimum of 24 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
      c. Features:
         1) Direct reading fuel level gauge.
         2) Normal atmospheric vent.
         3) Emergency pressure relief vent.
         4) Fuel fill opening with lockable cap.
         5) Dedicated electrical conduit stub-up area.
         6) Low fuel level switch.
         7) Leak detection switch; located within secondary containment interstitial space for detection of primary tank fuel leak.

C. Engine Starting System:
   1. System Type: Electric, with DC solenoid-activated starting motor(s).
   2. Battery(s):
      a. Battery Type: Lead-acid.
      b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
      c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
   3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
   4. Battery Charger:
      a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
      b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
      c. Listed as complying with UL 1236.
      d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
      e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
      f. Provide alarm output contacts as necessary for alarm indications.

D. Engine Speed Control System (Governor):

1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:
1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

F. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.

G. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

2.04 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 00001; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:
1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 00001, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 00001, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

2.05 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:
1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
2. Generator Set Control Functions:
a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
3. Generator Set Status Indications:

a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
b. Current (Amps): For each phase.
c. Frequency (Hz).
d. Real power (W/kW).
e. Reactive power (VAR/kVAR).
f. Apparent power (VA/kVA).
g. Power factor.
h. Duty Level: Actual load as percentage of rated power.
i. Engine speed (RPM).
j. Battery voltage (Volts DC).
k. Engine oil pressure.
l. Engine coolant temperature.
m. Engine run time.
n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (warning).
      6) Low oil pressure (shutdown).
      7) Overspeed (shutdown).
      8) Low fuel level (warning).
      9) Low coolant level (warning/shutdown).
      10) Generator control not in automatic mode (warning).
      11) High battery voltage (warning).
      12) Low cranking voltage (warning).
      13) Low battery voltage (warning).
      14) Battery charger failure (warning).
   b. In addition to NFPA 110 requirements, provide the following protections/indications:
      1) High AC voltage (shutdown).
      2) Low AC voltage (shutdown).
      3) High frequency (shutdown).
      4) Low frequency (shutdown).
      5) Overcurrent (shutdown).
      6) Fuel tank leak (warning), where applicable.
   c. Provide contacts for local and remote common alarm.
   d. Provide lamp test function that illuminates all indicator lamps.
5. Other Control Panel Features:
   a. Event log.

2.06 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Steel or aluminum.

C. Hardware Material: Stainless steel.

D. Color: Manufacturer's standard.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

2.07 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

C. Generator Set production testing to include, at a minimum:
1. Operation at rated load and rated power factor.
2. Single step load pick-up.
3. Transient and steady state voltage and frequency performance.
4. Operation of safety shutdowns.

D. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch (150 mm) high concrete pad constructed in accordance with Section 03 3000. Extend existing base as required for larger generator.

F. Provide required support and attachment in accordance with Section 26 0529.

G. Provide required vibration isolation and/or seismic controls in accordance with Section 26 0548.

H. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

I. Provide diesel fuel piping and venting in accordance with Section 23 1113, where not factory installed.

J. Install diesel fuel maintenance system in accordance with manufacturer's instructions.
1. Position fuel intake and fuel return within tanks to maximize fuel circulation.
2. Do not exceed lift capabilities of circulating pump.
3. Provide isolation valves, foot valves, priming tees, relief valves, and check valves where called for by manufacturer.

K. Provide engine exhaust piping in accordance with Section 23 5100, where not factory installed.
1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
2. Do not exceed manufacturer's maximum back pressure requirements.

L. Do not insulate piping for engine components restricted by manufacturer.

M. Provide grounding and bonding in accordance with Section 26 0526.

N. Identify system wiring and components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Notify Owner and Engineer at least two weeks prior to scheduled inspections and tests.

D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:
1. Inspect each system component for damage and defects.
2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
3. Check for proper oil and coolant levels.

G. Prepare and start system in accordance with manufacturer's instructions.

H. Perform acceptance test in accordance with NFPA 110.

I. Provide field emissions testing where necessary for certification.

J. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.

K. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

L. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.06 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

END OF SECTION 26 3213

SECTION 26 3600
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection of equipment specified in this section.

G. Section 26 3213 - Engine Generators: For interface with transfer switches.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

C. NEMA IA 10042-1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2025.

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.

G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Source quality control test reports.

E. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches:
   1. ABB: www.electrification.us.abb.com/#sle.
   2. Eaton Corporation: www.eaton.com/#sle.
   3. Schneider Electric; ASCO Power Technologies: www.ascopower.com/#sle.
   4. Source Limitations: Provide transfer switches and accessories produced by single manufacturer and obtained from single supplier.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:

D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.

E. Automatic Transfer Switch:
   1. Transfer Switch Type: As indicated on the drawings.
   2. Transition Configuration: As indicated on the drawings.
   3. Voltage: As indicated on the drawings.
   4. Ampere Rating: As indicated on the drawings.

5. Neutral Configuration: Solid neutral (unswitched), except as indicated.
6. Load Served: As indicated on the drawings.
7. Primary Source: As indicated on the drawings.
8. Alternate Source: As indicated on the drawings.

F. Basis of Design - Automatic Transfer Switch: Schneider Electric; ASCO 300 Series: www.ascopower.com/#sle.
   1. Non-Service-Entrance Switch:
      a. Frame: 150 A to 600 A.
      b. Transition Configuration: Open-transition.
      c. Neutral Configuration: Solid neutral.
      d. Phase Poles: As indicated on drawings.
      e. Ampere Rating: As indicated on drawings.
      f. Voltage: As indicated on drawings.
      g. Enclosure: As required for installed location.

G. Comply with NEMA IA 10042-1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

H. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

I. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

J. Switching Methods:
   1. Open Transition:
      a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
   2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

K. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

L. Enclosures:
   1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
   2. Finish: Manufacturer's standard unless otherwise indicated.

M. Short Circuit Current Rating:
   1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

N. Automatic Transfer Switches:
   1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
   2. Control Functions:
      a. Automatic mode.
      b. Test Mode: Simulates failure of primary/normal source.
      c. Voltage and Frequency Sensing:
         1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
         2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.

3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.

d. Outputs:
1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
2) Auxiliary contacts; one set(s) for each switch position.

e. Adjustable Time Delays:
1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
2) Transfer to alternate/emergency source time delay.
3) Retransfer to primary/normal source time delay.
4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.

f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.

g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.

3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.

4. Automatic Sequence of Operations:
a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Provide required seismic controls in accordance with Section 26 0548.

F. Install transfer switches plumb and level.

G. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Automatic Transfer Switches:
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.

D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

3.06 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

END OF SECTION 26 3600

SECTION 27 0529
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 27 0533.13 - Conduit for Communications Systems: Additional support and attachment requirements for conduits.

D. Section 27 1000 - Structured Cabling.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

F. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.

G. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.

H. MFMA-4 - Metal Framing Standards Publication; 2004.

I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

M. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

N. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

O. MSU Standards & Guidelines for Telecommunications Wiring & Installation - Defines the standards used for voice and data wiring in buildings used by MSU departments.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
   2. Coordinate work to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.

4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 3000.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, and post-installed concrete/masonry anchors.

B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

C. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

B. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.

C. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
a. TIA-569.
b. NFPA 70.
c. Applicable building code.
d. Requirements of authorities having jurisdiction.
e. MSU - Commscope Uniprise Certification.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with the manufacturer's application criteria as required for load to be supported [____]. Include consideration for vibration, equipment operation, and shock loads where applicable..
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for the environment where installed.
a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit Supports: Straps and clamps suitable for conduit to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Cable Supports: J-hooks, spaced every 4 feet, may be used for distribution of small cable bundles above suspended ceiling spaces, from major distribution routes to room outlet locations.
1. Applications:
a. Do not exceed 4 feet (1.2 m) between cable supports.
b. Maximum Number of Cables per Cable Support:
1) J-Hooks: 40 percent of fill capacity.
c. Allowable Cable Types:
1) J-Hooks: Category 6A.
2. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
3. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
c. Provide multitiered J-hooks where required to support multiple cabling systems.

D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

E. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.

F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Sheet Metal: Use self-tapping screws.
3. Wood: Use wood screws.
4. Plastic and lead anchors are permitted only as follows:
a. shall be used for plaster and concrete.
5. Attachment to drywall alone should be avoided.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Engineer, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
   2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners in accordance with manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION 27 0529

SECTION 27 0533.13
CONDUIT FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Galvanized steel electrical metallic tubing (EMT).

C. Stainless steel electrical metallic tubing (EMT).

D. Aluminum electrical metallic tubing (EMT).

E. Rigid polyvinyl chloride (PVC) conduit.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 26 0533.13 - Conduit for Electrical Systems.

C. Section 27 1000 - Structured Cabling.

1.03 REFERENCE STANDARDS

A. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

B. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.

C. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.

D. BICSI TDMM - Telecommunications Distribution Methods Manual, 15th Edition; 2024.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises; 2020e.

J. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

K. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

M. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

N. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

O. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.

P. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.05 QUALITY ASSURANCE

A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, TIA-569, BICSI ITSIMM, BICSI TDMM, manufacturers' instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, reinforced thermosetting resin conduit (RTRC), or high-density polyethylene (HDPE) conduit.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Use galvanized steel electrical metallic tubing (EMT) or aluminum electrical metallic tubing (EMT). Embed within structural slabs only where approved by Structural Engineer.
   2. Within Slab Above Ground: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or aluminum electrical metallic tubing (EMT). Embed within structural slabs only where approved by Structural Engineer.
   3. Within Concrete Walls Above Ground: Use galvanized steel electrical metallic tubing (EMT) or aluminum electrical metallic tubing (EMT).
   4. Where aluminum rigid metal conduit (RMC) and aluminum electrical metallic tubing (EMT) is installed in concrete, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or aluminum electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel electrical metallic tubing (EMT), aluminum electrical metallic tubing (EMT), or inside-plant flexible nonmetallic communications raceway/innerduct.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), or aluminum electrical metallic tubing (EMT).

I. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel electrical metallic tubing (EMT) or stainless steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70 and TIA-569.

B. Provide conduit, fittings, supports, and accessories required for complete communications pathway.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Communications Outlet Box: 1-1/4-inch (35 mm) trade size.

2. Continuous Conduit Homerun Serving One Communications Outlet Box: 1-1/4-inch (35 mm) trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, BICSI TDMM, and MSU Standards & Guidelines for Telecommunications Wiring & Installation, but not less than 1 1/4". Where specified standards differ, comply with most stringent.

2.03 FLEXIBLE METAL CONDUIT (FMC)

A. Is expressly prohibited from use.

2.04 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use compression/gland or set-screw type.
a. Do not use indenter type connectors and couplings.
4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

2.05 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
3. Connectors and Couplings: Use compression/gland or set-screw type.
4. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

2.06 ALUMINUM ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT aluminum electrical metallic tubing listed and labeled as complying with UL 797A.

B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; listed for use with aluminum EMT.
2. Material: Use aluminum.
3. Connectors and Couplings: Use compression/gland or set-screw type.
a. Do not use indenter type connectors and couplings.
4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install conduit in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.

C. Galvanized Steel Electrical Metallic Tubing (EMT): Install in accordance with NECA 101.

D. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Communications rooms.
      c. Mechanical equipment rooms.
      d. Within joists in areas with no ceiling.
   4. Unless otherwise approved, do not route exposed conduits:
      a. Across floors.
      b. Across top of parapet walls.
      c. Across building exterior surfaces.
   5. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   6. Arrange conduit to maintain adequate headroom, clearances, and access.
   7. Arrange conduit to provide no more than equivalent of two 90-degree bend(s) between pull points.
   8. Arrange conduit to provide no more than 100 feet (33 m) between pull points.
   9. Arrange conduit to provide minimum bend radii in accordance with BICSI TDMM.
   10. Route conduits above water and drain piping where possible.
   11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   12. Maintain recommended separation from sources of EMI greater than 5 kVA in accordance with BICSI ITSIMM and BICSI TDMM.
   13. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
   14. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.

E. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   5. Use metal channel/strut with accessory conduit clamps to support multiple, parallel, surface-mounted conduits.
   6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   7. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

F. Connections and Terminations:

1. Use suitable adapters where required to transition from one type of conduit to another.
2. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect cables.
3. Secure joints and connections to provide mechanical strength and electrical continuity.

G. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves and/or slots for penetrations as indicated or as required to facilitate installation.
4. Conceal bends for conduit risers emerging above ground.
5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.

H. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
a. Underground, Exterior: 18 inches (460 mm).

I. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed cables or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

J. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
a. Where conduits enter building from outside.
b. Where service conduits enter building from underground distribution system.
c. Where conduits enter building from underground.
d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
a. Where conduits pass from outdoors into conditioned interior spaces.
b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

K. Provide grounding and bonding.

3.03 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of cables.

END OF SECTION 27 0533.13

SECTION 27 1000
STRUCTURED CABLING - COMMSCOPE SYSTIMAX/UNIPRISE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Copper Cable and Terminations:
   1. Copper twisted pair cables.
   2. Modular jacks.
   3. Copper twisted pair patch cords.
   4. Copper twisted pair ceiling connector assemblies.

B. Communications Equipment Room Fittings:
   1. Copper panels.
   2. Equipment racks.
   3. Horizontal/vertical cable managers.

C. Communications faceplates.

1.02 RELATED REQUIREMENTS

A. MSU Standards & Guidelines for Telecommunications Wiring & Installation

1.03 ABBREVIATIONS AND ACRONYMS

A. P/N: Part number; manufacturer's material identification number.

B. RU: Rack unit; 1-3/4 inches (44 mm) of rack height.

1.04 REFERENCE STANDARDS

A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.

B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2024.

E. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2018d, with Addenda (2020).

F. TIA-568.3 - Optical Fiber Cabling and Components Standard; 2022e.

G. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

H. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2024e.

I. UL 2416 - Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems; Current Edition, Including All Revisions.

J. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

K. UL 444 - Communications Cables; Current Edition, Including All Revisions.

L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

M. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.

N. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

O. MSU Standards & Guidelines for Telecommunications Wiring & Installation

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work to avoid placement of other utilities or obstructions within spaces dedicated for communications equipment.
2. Coordinate arrangement of communications equipment with dimensions and clearance requirements of actual equipment to be installed.
3. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

D. Field Quality Control Submittals: Documentation of cable testing results and corrective actions taken.

E. Commscope's Uniprise qualification statement.

1.07 CORNING'S LANSCAPE NPI-PARTICIPANT QUALIFICATION STATEMENT.

A. Installer's qualification statement for both Commscope Uniprise and Corning LANscape.

B. Manufacturer's qualification statement.

C. Installer's qualification statement.

D. Executed warranty.

E. Project Record Documents: Indicate actual locations of system components and cable routing.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:
1. Company with at least 3 years experience in installation and testing of structured cabling.
2. Corning Authorized Partner - LANscape NPI-Participant.
3. Commscope Authorized Partner - Uniprise Equipment Level.

B. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.10 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions before, during, and after installation.

1.11 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Extended Network Infrastructure System Warranty:
1. Provide 25-year manufacturer warranty for passive structured cabling system components.
2. Comply with manufacturer's requirements for warranty validation including, but not limited to:
   a. Use only products from manufacturer's approved end-to-end solution.
   b. Obtain products from manufacturer's authorized supplier.
   c. Install products in accordance with manufacturer's instructions.
   d. Perform testing and submit test reports required by manufacturer.
   e. Complete warranty documentation in Owner's name and register with manufacturer within required time period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: CommScope, Inc; UNIPRISE; www.commscope.com/#sle.

B. Substitutions: Not permitted.

2.02 STRUCTURED CABLING SYSTEM - GENERAL REQUIREMENTS

A. Comply with the following:
   1. TIA-568 (SET).
   2. TIA-569.
   3. TIA-607.
   4. NFPA 70.
   5. Requirements of authorities having jurisdiction.
   6. Applicable local codes.

2.03 COPPER CABLE AND TERMINATIONS

A. Copper Twisted-Pair Cables:
   1. Comply with TIA-568.2; listed as complying with UL 444.
   2. Cable Applications:
      a. Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
      b. Riser Applications: Use listed NFPA 70 Type CMR riser cable or Type CMP plenum cable.
      c. General Purpose Applications: Use listed NFPA 70 Type CM/CMG general purpose cable, Type CMR riser cable, or Type CMP plenum cable.
   3. Products:
      a. Part numbers specified are for boxes or reels with 1,000-foot (305 m) cable length unless otherwise indicated.
      b. UNIPRISE CS44 Series Category 6A U/UTP Cable, nonplenum CMR rated, 4-pair, 23 AWG; CS44R Series.
         1) Cable Jacket Color - Network: Gray (GRY), P/N UN884019314/10.
      c. UNIPRISE CS44 Series Category 6A U/UTP Cable, plenum CMP rated, 4-pair, 23 AWG; CS44P Series.
         1) Cable Jacket Color - Network: Gray (GRY), P/N UN874044414/10.

B. Modular Jacks:
   1. Description: RJ-45, nonkeyed, 8-position modular jacks with insulation displacement connectors (IDC); high-impact thermoplastic housing.
   2. Comply with TIA-568.2, match cable; UL 1863 listed.
   3. Color code for both T568A and T568B wiring configurations.
   4. Plug Insertion Life: 750 times, minimum.
   5. Flammability: Comply with UL 94.
   6. Products:
      a. UNIPRISE USL10G Series Category 6A U/UTP Modular Jacks, SL opening, with dust cover.
         1) Color - Network: Light Almond, P/N 7602241137

C. Copper Twisted Pair Patch Cords:
   1. Description: Factory-fabricated, 4-pair cable assemblies with RJ45, 8-position modular jacks terminated at each end; length as indicated or as required.
   2. Comply with TIA-568.2.
   3. Wiring: T568B.
   4. Plug Insertion Life: 750 times, minimum.
   5. Flammability: Comply with UL 94.
   6. Patch Cords for Patch Panels:
   7. Products:

a. Part numbers specified include "XXX" in place of length.
b. UNIPRISE ULTRA 10 UNC10G Series Category 6A U/UTP Patch Cord, snagless.
1) Cable Jacket Color - Network: Gray, P/N UC1AAA2-0CFXXX.

2.04 COMMUNICATIONS FACEPLATES

A. Listed as complying with UL 514C.

B. Compatible with specified modular jacks/inserts.

C. Provide blank inserts/dust covers for unused ports.

D. Faceplate Material/Finish - Flush-Mounted Outlets: Match power wiring device and faceplate finishes specified on drawings.

E. Products:
1. CommScope NAR Series Single-Gang Thermoplastic Faceplates, with openings for SL Series modular jacks and provisions for labels.
a. Single-gang, 2 ports, thermoplastic, light almond, label; P/N 760249153.
b. Single-gang, 4 ports, thermoplastic, light almond, label; 760249154.
c. Single-gang, 6 ports, thermoplastic, almond, label; P/N 760249155.
2. CommScope SL Series CAT6A inserts, thermoplastic.
a. Light almond; Model USL10G-L.AG; P/N 760241137
3. CommScope SL Series blanking inserts, thermoplastic.
a. Light almond; P/N 1116407-1

END OF SECTION 27 1000

SECTION 28 4600
FIRE DETECTION AND ALARM

2.2.4.1.41. GENERAL

1.1 REFERENCE STANDARDS

A. IEEE 1100 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment; 2005.

B. ISO 9000 - Quality Management Systems -- Fundamentals and Vocabulary; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

E. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

F. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

G. UL 497B - Standard for Protectors for Data Communications and Fire-Alarm Circuits; Current Edition, Including All Revisions.

H. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

I. UL 1480 - Standard for Speakers for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

J. UL 1638 - Standard for Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

K. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

1.2 REFERENCES

1.2.1 Codes-General

All work and materials shall conform to all applicable federal, state, and local codes and regulations governing the installation. If there is a conflict between the referenced standards, federal, state, or local codes, and this specification, it is the bidder’s responsibility to immediately bring the conflict to the attention of the engineer for resolution. National standards shall prevail unless local codes are more stringent.

The bidder shall not attempt to resolve conflicts directly with the local authorities unless specifically authorized by the Engineer.

1.2.2 REGULATORY AGENCIES

1.2.2.1 The term jurisdictional authority used in this section of the specification shall include, as applicable, but not be limited to the following:

1.2.2.1.1 State of Montana Building Codes Division.

1.2.2.1.2 Bozeman Fire Department.

1.2.2.1.3 MSU Department of Safety and Risk Management

1.2.2.1.4 Owner.

1.2.3 The design and installation of all systems of fire protection shall conform to all requirements of applicable codes and publications herein defined:

1.2.3.1 International Building Code (2021)

1.2.3.2 International Existing Building Code (2021)

1.2.3.3 International Fire Code (2012)

1.2.3.4 NFPA #13: Standard for the Installation of Sprinkler System (2019)

1.2.3.5 NFPA #72: National Fire Alarm and Signaling Code (2019)

1.2.3.6 NFPA #70: National Electrical Code (2020)
1.2.3.7 All State and local ordinances
1.2.3.8 Underwriters' Laboratories
1.2.3.9 American Society of Testing Materials
1.2.3.10 American National Standards Institute
1.2.3.11 Occupational Safety and Health Administration

1.3 SYSTEM DESCRIPTION

1.3.1 Fire Alarm Performance
1.3.1.1 General Requirements
1.3.1.1.1 Comply with the provisions of NFPA 72 and the operational requirements of this specification.
1.3.1.1.2 The system shall identify all off normal conditions and log each condition into the system as an event.
1.3.1.1.2.1 The system shall automatically display on the control panel Color Liquid Crystal Display (LCD) the first (oldest) event of the highest priority by type. The event priority shall be alarm, supervisory, trouble, and monitor.
1.3.1.1.2.2 The display shall incorporate a touch screen to aid in navigation between event types and system operation.
1.3.1.1.2.3 The system shall not require a user to navigate the LCD display to operate the main control functions of (Panel Silence, Alarm Silence, and Reset). These controls shall be located near the LCD display, be easily found, be tactile in nature and be provided with color coding and be local language/dialect adaptable, operation of the switch shall provide illuminated feedback of the switch activation.
1.3.1.1.2.4 The touch screen option of the LCD display must be operable without the use of a stylus and must be resistive in nature, capacitive touch screens shall not be considered as operationally equivalent. A minimum of 8 events must be visible on the LCD without operator intervention.
1.3.1.1.2.5 The system shall utilize a minimum of ten color coded event queues on the LCD screen to group event types.
1.3.1.1.2.6 The system shall provide the following event queues as a minimum each to include a count of active events for the queue type including a visible indicator showing if events have not been reviewed: Alarm, Emergency, Supervisory, Disable/Test, Trouble, Ground Fault, Monitor, Fire Phone call in, Requested/Granted control.
1.3.1.1.2.7 Labeled, color coded indicators shall be provided for each of the following event groups in addition to the LCD queues, indicators shall be provided for alarm - red, supervisory - yellow, trouble - yellow, monitor - Green. The colors used for display of events shall follow the Federal Standard 595 Safety Color chart using the following colors: red (11120), yellow (13591), green (14120), and blue (15092). When an unviewed event exists for a given type, the queue indicator shall be marked.
1.3.1.1.2.8 For each event, the display shall include a sequential event number, time stamp, the type of event, and a minimum of 40-character custom user location description.
1.3.1.1.2.9 The display shall support a rich set of Unicode symbols to better define messaging including but not limited to radioactive symbols, poisonous substances (skull and crossbones) symbol, biological hazard symbol and Caduceus symbol.
1.3.1.1.2.10 The user shall be able to review each event queue by simply selecting scroll arrows (up-down) or 'swipe' navigation for the event type.
1.3.1.1.2.11 New alarm, supervisory, or trouble events shall sound a distinct, silenceable audible signal at the control panel. Silenced audible signal will

resound in a time period acceptable to the AHJ if off normal condition has not been resolved.

1.3.1.1.2.12 The LCD shall show the system time and disabled points in the system.

1.3.1.1.2.13 Specific input/output devices shall operate in accordance with the alarm, supervisory, trouble, monitor sections that follow and the input/output matrix.

1.3.1.1.2.14 A detailed report of specific off normal conditions shall be accessible directly from the displayed event.

1.3.1.1.2.15 For disabled devices the ability to select the disable event, view details and enable the device shall be accomplished in no more than 3 screen touches.

1.3.1.1.2.16 All critical systems, sub-systems and circuits shall be monitored for integrity. System faults shall be annunciated.

1.3.1.1.2.17 Strobes shall be synchronized on each floor.

1.3.1.1.2.18 Audio shall be synchronized on each floor.

1.3.1.1.2.19 Batteries shall be sized to support the system for 24 hours of standby operation followed by 15 minutes of alarm operation at the end of the 24-Hour period. Battery sizing calculations shall include a minimum of 20% oversizing or as defined elsewhere in this specification.

1.3.1.1.2.20 Off-premises reporting of the loss of AC mains power to any system component shall be automatically delayed for a period of time acceptable to the AHJ to reduce traffic at the central monitoring station due to wide-area power failures.

1.3.1.1.2.21 The system shall provide configurable service groups to facilitate “one man” testing of the system based on the physical layout of the building. Each service group shall be capable of supporting any combination of system devices, independent of the circuit on which they are installed. Systems that disable entire circuits, circuits serving multiple floors or fire zones for testing shall not be considered as equal. Activated or faulted devices and circuits in a service group shall be capable of initiating alternative system test responses to facilitate system maintenance and minimizing occupant disturbances while in test mode.

1.3.1.1.2.22 Event processing and display shall be prioritized as follows:

1.3.1.1.2.22.1 Life Safety

1.3.1.1.2.22.2 Property Safety

1.3.1.1.2.22.3 Supervisory/System Integrity events

1.3.1.1.2.22.4 All other events

1.3.1.2 Alarm Operation

1.3.1.2.1 Upon the alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler waterflow the following functions shall automatically occur:

1.3.1.2.2 The system shall remain in alarm mode until all initiating devices are reset and the fire alarm panel is manually reset and restored to normal.

1.3.1.2.3 The internal audible device shall sound at the control panel or command center.

1.3.1.2.4 The LCD display shall indicate all applicable information associated with the alarm condition including; zone, device type, device location and time/date.

1.3.1.2.5 Any remote or local annunciator LCD/LEDs associated with the alarm zone shall be illuminated.

1.3.1.2.6 An evacuation message shall be sounded on all floors. It is the intent of this message to advise occupants hearing this message that they are near danger and should immediately leave the building consistent with the building’s emergency plan: stairs (nearest exit), do not use elevators.

1.3.1.2.7 Activate visual strobes on all floors immediately. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed.

1.3.1.2.8 The notification appliance dedicated to the sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.

1.3.1.2.9 Transmit signal to the building automation system.

1.3.1.2.10 Transmit signal to the central monitoring station with point identification.

1.2.1.2.11 All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

1.3.1.2.12 Activation of elevator lobby or elevator equipment room smoke detectors shall initiate recall of the bank of elevators to the 1st floor and lockout the elevator controls. Activation of the first-floor elevator lobby smoke detector shall recall to an alternate floor and lockout the elevator controls.

1.3.1.2.13 Activation of heat detectors in elevator shafts and machine rooms shall activate the elevator power shunt trip circuit breaker.

1.3.1.3 Supervisory Operation

1.3.1.3.1 Upon supervisory activation of any sprinkler valve supervisory switch, tamper or elevator shunt trip supervision, the following functions shall automatically occur:

1.3.1.3.2 The internal supervisory event audible device shall sound at the control panel.

1.3.1.3.3 The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.

1.3.1.3.4 All system activity/events shall be documented on the system printer and logged to system history.

1.3.1.3.5 Any remote or local annunciator LCD/LEDs associated with the supervisory zone shall be illuminated.

1.3.1.3.6 Transmit signal to the central monitoring station with point identification.

1.3.1.4 Trouble Operation

1.3.1.4.1 Upon activation of a trouble condition or signal from any device or internal system integrity monitoring function on the system, the following functions shall automatically occur:

1.3.1.4.2 The internal panel audible device shall sound at the control panel.

1.3.1.4.3 The LCD display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.

1.3.1.4.4 Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not prevent the logging of trouble events to the historical file.

1.3.1.4.5 All system activity/events shall be documented on the system printer and logged to system history.

1.3.1.4.6 Any remote or local annunciator LCD/LEDs associated with the trouble zone shall be illuminated.

1.3.1.4.7 Transmit a trouble signal to the central monitoring station with point identification.

1.3.1.5 Monitor Operation

1.3.1.5.1 Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:

1.3.1.5.2 The internal panel audible device shall sound at the control panel.

1.3.1.5.3 The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.

1.3.1.5.4 All system activity/events shall be documented on the system printer and logged to system history.

1.3.1.5.5 Any remote or local annunciator LCD/LEDs associated with the monitor circuit shall be illuminated.

1.4 SUBMITTALS

1.4.1 Submittal General

1.4.1.1 The contractor shall not purchase any equipment for the specified system until the Authority Having Jurisdiction (AHJ) has approved the project submittals in their entirety and has returned them to the Engineer.

1.4.1.2 Approved submittals allow the Contractor to proceed with the installation and shall not be construed to mean that the Contractor has satisfied the requirements of these specifications.

1.4.1.3 Any conflicts in the contract documents and/or with AHJ requirements shall be submitted to the Owner in writing 7 days prior to bid.

1.4.2 Product Data

1.4.2.1 Product data package has been completed by the Engineer and will be submitted to the AHJ for approval. Copies of AHJ approval will be submitted to the Contractor when completed.

1.4.3 Design Calculations

1.4.3.1 Design calculations have been completed by the Engineer and will be submitted to the AHJ for approval. Copies of AHJ approval will be submitted to the Contractor when completed.

1.4.4 Shop Drawings

1.4.4.1 Shop drawings have been completed by the Engineer and will be submitted to the AHJ for approval. Copies of AHJ approval will be submitted to the Contractor when completed.

1.4.4.2 Upon receipt of approved drawings from the Authority Having Jurisdiction, the Owner shall immediately forward the approved drawings to the Contractor. These drawings shall either be stamped approved or a copy of the letter stating approval shall be included.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Supplier

1.5.1.1 The System Supplier shall have a minimum of 10 years of experience in distribution and service of the proposed equipment brand.

1.5.1.2 The Supplier shall have successfully designed and installed similar system fire detection, evacuation voice and visual signaling control components on a previous project of comparable scope, size, and complexity.

1.5.1.3 The Supplier shall have in-house engineering and project management capabilities consistent with the requirements of this project. The project shall be supervised by personnel certified by NICET as fire alarm Level IV technicians.

1.5.1.4 The Supplier shall employ qualified and manufacturer-certified system designers to perform the detailed engineering design, system calculations, for all the system equipment and programming.

1.5.1.5 The Supplier shall produce all panel and equipment drawings, submittals, and operating manuals, as detailed elsewhere in this specification.

1.5.1.6 The Supplier shall be responsible for providing qualified on-site representative(s) for coordination of system installation, and final system testing and commissioning in accordance with these specifications.

1.5.2 Qualifications of Installer

1.5.2.1 Before commencing work, submit evidence showing that the equipment installer has successfully installed systems of the similar scope, type and design as specified.

1.5.2.2 The contractor/installer shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

1.5.2.3 The contractor/installer shall be responsible for retaining qualified and authorized representative(s) of the system manufacturer (the Supplier) specified for detailed system design and documentation, coordination of system installation requirements, and final system testing and commissioning in accordance with NFPA 72 and these specifications.

1.5.2.4 The Contractor/Installer shall employ on staff a minimum of one NICET level II Technician or a Professional Engineer, registered in the State of the installation.

1.5.2.5 Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

1.6 HANDLING

1.6.1 Delivery and Storage

1.6.1.1 Receiving

1.6.1.2 The Contractor shall be responsible for all receiving, handling, and storage of the materials at the job site.

1.6.1.3 Overnight storage of materials is limited to the assigned storage area. Materials brought to the work area shall be installed the same day or returned to the assigned storage area unless previously approved by the Owner.

1.6.1.4 The Contractor shall remove rubbish and debris resulting from their work on a daily basis. Rubbish not removed by the Contractor will be removed by the Owner and back charged to the Contractor.

1.7 PROJECT CONDITIONS

1.7.1 Responsibility

1.7.1.1 It shall be the Contractor's responsibility to inspect the job site and become familiar with the conditions under which the work will be performed.

1.7.1.2 A pre-bid meeting will be held to familiarize the Contractors with the project. Failure to attend the pre-bid meeting may be considered cause for rejection of the contractor's bid. The minutes of this meeting will be distributed to all attendees and shall constitute an addendum to these specifications.

1.7.1.3 All work may be conducted during normal working hours, 8:00 a.m. to 5:00 p.m., Monday through Friday.

1.8 WARRANTY

1.8.1 Installation Workmanship and Parts

1.8.1.1 The Contractor shall warranty the installation and workmanship for one (1) year and all parts for thirty-six (36) months from date of final acceptance. A copy of the manufacturer’s warranty shall be provided with closeout documentation and included with the operation and installation manuals. The full cost of maintenance, labor and materials required to correct any defect during the warranty period shall be included in the submittal bid.

1.8.1.2 During the warranty period, each year the Contractor shall perform detector sensitivity testing and provide a report to the Owner. If the system is UL Listed to perform automatic detector sensitivity testing without manual intervention, and if a detector falls outside of sensitivity window the system automatically indicates a devices trouble, then this requirement shall be waived. Documentation from UL shall be provided as proof of automatic sensitivity testing operation.

1.8.1.3 The system supplier shall maintain a service organization with adequate spare parts stock within 75 miles (120.7 kilometers) of the installation. Provide a telephone response to Owner’s questions within 4 hours and on-site assistance within 24 hours.

1.8.1.4 Permit the Owner’s fire alarm Technicians to perform temporary bypasses and emergency repairs on the system without voiding the warranty.

1.9 STARTUP AND COMMISSIONING

1.9.1 Test and Inspection

1.9.1.1 Testing, general

1.9.1.1.1 In addition to tests required in this section, the Contractor shall perform all electrical and mechanical tests required by the equipment manufacturer, the Architect and the Authority Having jurisdiction.

1.9.1.1.2 The Contractor shall perform all testing in occupied facilities at times of day that present the lowest impact and disruption to business and activities. Coordinate all testing in occupied buildings with the Building Owner's Representative to assure that fire alarm system testing does not interrupt operations. This may require extensive after- hours work to perform such testing.

1.9.1.1.3 All equipment, instruments, tools, and labor required to conduct the system tests shall be provided by the installation Contractor. At a minimum, the following equipment shall be made available for testing:

1.9.1.1.3.1 Ladders and scaffolds as required to reach all installed equipment.

1.9.1.1.3.2. Meters for reading voltage, current and resistance.

1.9.1.1.3.3 Two-way communication devices

1.9.1.1.3.4 Simulated smoke, heat-producing devices for heat detectors, extension poles for introducing smoke into detectors, as needed.

1.9.1.1.3.5 Manufacturer's instruments to measure air flow through duct smoke detectors.

1.9.1.1.3.6. Decibel meter and intelligibility testing equipment.

1.9.1.1.3.7. Status and diagnostic software and PC.

1.9.1.1.4 All testing shall utilize a written acceptance test plan for testing the system components and operation in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the acceptance test plan, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and system programming.

1.9.1.1.4.1 The systems operation matrix created by the equipment supplier shall be used to identify each alarm input and verify all associated output functions.

1.9.1.1.5 The system test plan shall include but not be limited to the following:

1.9.1.1.5.1 Visually inspect all wiring.

1.9.1.1.5.2 Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final acceptance test.

1.9.1.1.5.3 System wiring shall be tested to demonstrate correct system response for the following conditions:

1.9.1.1.5.3.1 Open, shorted, and grounded signal line circuits.

1.9.1.1.5.3.2. Open, shorted, and grounded notification appliance circuits.

1.9.1.1.6 System indications shall be demonstrated as follows:

1.9.1.1.6.1 Correct message content for each alarm input at all system displays.

1.9.1.1.6.2. Correct annunciator light for each alarm input at each graphic display.

1.9.1.1.6.3. Correct history logging for all system activity.

1.9.1.1.6.4. Correct sensitivity for all smoke detection devices. The use of system generated sensitivity reports is acceptable in meeting this requirement.

1.9.1.1.6.5. Correct signals sent to the Central Monitoring Station.

1.9.1.1.7 Notification appliances shall be demonstrated as follows:

1.9.1.1.7.1. All alarm notification appliances actuate as programmed.

1.9.1.1.7.2 Audibility and visibility at required levels. The system shall be tested for interior building audibility of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be tested to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of [0.5] inch ([12.7] mm) all areas designated on the drawings to have intelligible audio. The

mean value of at least 3 readings shall be required to compute the intelligibility score at each test location.

1.9.1.1.7.3 HPSAs shall be tested for an outside audibility level of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be tested to ensure a Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 inch (12.7 mm) outdoor areas during normal weather conditions. Intelligibility may be less than 0.7 CIS in areas of the zone if it can be determined that a voice signal is being broadcast and an individual could walk less than 164 feet (4998.72 cm) to find a location in the zone with at least 0.7 CIS. Values of 0.65 through 0.74 shall be rounded to 0.7. The mean value of at least 3 readings shall be required to compute the intelligibility score at each test location.

1.9.1.1.7.4 For 24VDC NACS, measure and record the voltage at the most remote appliance on each notification appliance circuit, while operating.

1.9.1.1.8 System control functions shall be demonstrated as follows:

1.9.1.1.8.1. In accordance with the system operation matrix.

1.9.1.1.8.2. System off premises reporting functions shall be demonstrated as follows:

1.9.1.1.8.3. Correct information received for each alarm and trouble event.

1.9.1.1.9 Secondary power supply (battery) capacity capabilities shall be demonstrated as follows:

1.9.1.1.9.1 System battery voltages and charging currents shall be measured and recorded on the fire alarm control panels.

1.9.1.1.9.2 The system’s primary power shall be disconnected for 24 hours. At the end of that period, an alarm condition shall be created, and the system shall perform as specified for a period of 15 minutes.

1.9.1.1.9.3 The system’s primary power shall be restored in forty-eight (48) hours.

1.9.1.1.9.4. System battery voltages and charging currents shall again be measured and recorded on the fire alarm control panels.

1.9.1.2 Verify the “As Built” record drawings are accurate.

1.9.2 Preliminary Testing

1.9.2.1 Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of the written test plan. Correct any deficiencies, omissions or anomalies and retest the affected devices to assure proper function per the specification.

1.9.3 Acceptance Testing

1.9.3.1 A final acceptance test shall not be scheduled until the system manuals are provided to and approved by the Owner and the following are provided at the job site:

1.9.3.1.1 “As Built” record drawings of the system as actually installed.

1.9.3.1.2 A copy of the system operation matrix.

1.9.3.1.3 The acceptance Inspector shall use the system “As Built” record drawings in combination with the system operation matrix and the written acceptance test plan during the testing to verify system operation.

1.9.3.1.4 Should the system not perform to the above criteria it shall not be accepted and the Contractor shall correct all deficiencies and shall re-test the system at Contractor's expense in the presence of the architect using the same test criteria.

1.9.3.2 The Building Owner’s Representative shall witness the final tests.

1.9.3.3 The Central Monitoring Station and/or Fire Department shall be notified before the final test in accordance with local requirements.

1.9.3.4 Operate every installed device to verify proper operation and correct annunciation at control panel.

1.9.3.5 Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.

1.9.4 Test Reports

1.9.4.1 A "Fire Alarm System Record of Completion" per the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72 shall be prepared by the Contractor. Submit three (3) copies to the Architect. The report shall include, but not be limited to:

1.9.4.2 A list of all equipment installed and wired.

1.9.4.3 Certification that all equipment is properly installed and functions and conforms with these specifications.

1.9.4.4 Sensitivity settings for each smoke detector as measured in place with the HVAC system operating.

1.9.4.5 Technician's name, certificate number and date.

1.9.5 Training

1.9.5.1 The system supplier shall schedule and present a minimum of eight (8) hours of formal site-specific instruction for the building owner, detailing the proper operation and maintenance of the installed system.

1.9.5.2 The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

1.9.5.3 The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

1.9.5.4 Copies of all training aids, presentations, etc. shall be left with the Owner.

2. PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 The manufacturer of the system equipment shall be regularly involved in the design, manufacture, and distribution of the products specified in this document. These processes shall be monitored under a quality assurance program that meets ISO 9000/9001 requirements.

2.1.2 The catalog numbers used are those of EDWARDS, a UTC Company or equal, and constitute the type and quality of equipment to be furnished. For a list of EDWARDS authorized fire alarm vendors, contact: <<a
href="http://edwardsfiresafety.com/">http://edwardsfiresafety.com>

2.1.3 All products used shall be of a single manufacturer. All products shall be listed by the manufacturer for their intended purpose. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.

2.1.4 Approved Products: All panels and peripheral devices shall be of the standard product of a single manufacturer and shall display the manufacturer’s name of each component. The catalog numbers specified under this section are those of EDWARDS, a UTC Company, and shall constitute the type, product quality, material and desired operating features.

2.2 FIRE ALARM PANEL

2.2.1 General - Fire

2.2.1.1 Overview

2.2.1.1.1 All materials, equipment, accessories, devices and other facilities and appurtenances covered by these specifications or noted on the drawings shall be new, best suited for the intended use and shall conform to applicable and recognized standards for their use and supplied by a single manufacturer. Should any equipment provided under this specification be supplied by a different manufacturer, that equipment shall be recognized compatible by BOTH manufacturers and listed as such as required by Underwriters’ Laboratories.

2.2.1.1.2 The fire alarm control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way and two-way emergency audio

communications, extinguishing agent releasing system? and smoke control applications. The control panel shall be listed and approved for the application standard(s) as listed in the References section of this specification.

2.2.1.1.3 The control panel shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured and modified using software provided by the manufacturer. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

2.2.1.1.4 The operating controls shall be located in a dead-front steel enclosure behind a locked door with a viewing window. All control modules shall be labeled, and all zone locations shall be identified. All panel modules shall be placement supervised and signal a trouble if damaged or removed.

2.2.1.2 System Features

2.2.1.2.1 Each control panel shall include the following capabilities:

2.2.1.2.2 Support multiple languages / dialects.

2.2.1.2.3 Supervision of the system electronics, wiring, detection devices and software

2.2.1.2.4 Up to 2500 analog/addressable input/output points

2.2.1.2.5 Network, a dedicated IPv6 configuration and support mesh configuration.

2.2.1.2.6 Network configuration support for Class A, Class B, Class X, Class N.

2.2.1.2.7 Network physical media connections via fiber, twisted pair, or CAT5 in any combination.

2.2.1.2.8 Network distance between two panels up to 3,280ft using CAT5 wire, 5,000 feet (152400 cm) using twisted pair wire.

2.2.1.2.9 Networks deployed with CAT5 wire shall support Class A, Class B, Class X, Class N, mesh wiring topologies.

2.2.1.2.10 Network support for back-to-back pass through degraded-mode operation for media- to-media applications.

2.2.1.2.11 Network back-to-back pass though shall maintain network connectivity on power down or catastrophic failure of a single panel.

2.2.1.2.12 The ability to download all applications and firmware from the configuration computer at a single location on the fire network.

2.2.1.2.13 The ability to upload project files from any location on the fire network.

2.2.1.2.14 Panel time, panel audible signal patterns, and indicator flash rates are synchronized across the network.

2.2.1.2.15 Connections to outside systems shall be made via a listed for the purpose firewall interface.

2.2.1.2.16 Support multiple dialers (DACTs) and modems, IP communication to the central station and cellular connections.

2.2.1.2.17 Support multiple IP connections to external services including central stations, email servers, web interfaces, and reports.

2.2.1.2.18 Email messages support multiple languages in native characters and match the languages supported in the panel.

2.2.1.2.19 Email messages support symbolic and color alarm event high lighting.

2.2.1.2.20 System reports provide a graphical representation of sensitivity thresholds, detector dirty level and CO Life left.

2.2.1.2.21 An internal audible signal with different patterns to distinguish between alarm, supervisory, trouble and monitor events.

2.2.1.2.22 Support multiple 24 VDC and Audio NACs

2.2.1.2.23 Configurable switches and LED indicators to support auxiliary functions with software selectable LED colors of Red, Yellow, Blue, Green or White.

2.2.1.2.24 User interface through color touch screen LCD display.

2.2.1.2.25. Log up to 20,000 chronological events.

2.2.1.2.26 A real-time clock for time stamps and timed event control with onboard power back- up
2.2.1.2.27 Electronic addressing of intelligent addressable devices
2.2.1.2.28 Provide an independent hardware watchdog to supervise software and CPU operation.
2.2.1.2.29 The ability for “Dry” alarm, trouble and supervisory relay contacts
2.2.1.2.30 Control panel modules shall plug into a chassis assembly for ease of maintenance.
2.2.1.2.31. Field wiring shall connect to the panel using removable connectors.
2.2.1.3 User Oriented Features
2.2.1.3.1 Each control panel shall include the following user-oriented features:
2.2.1.3.1.1 A color touchscreen LCD user interface control/display that shall annunciate and control system functions.
2.2.1.3.1.2 Provide discreet system control switches for reset, alarm silence, panel silence, drill switch, these system control switches shall be constructed of a silicon rubber to provide tactile feedback and include an accompanying indicator that shall provide additional visual feedback of switch activation. Overlay style embedded switches are not considered equal.
2.2.1.3.1.3 The reset, alarm silence, panel silence and drill system control switches shall provide color coding for ease of distinguishing one from the other.
2.2.1.3.1.4 Color LCD shall provide visibility of 8 events hands free. Each event can include a minimum of 40-character site specific location text. The LCD allows the use of on screen scrolling via display switches or by ‘swiping’ the display screen.
2.2.1.3.1.5 A “lamp test” feature shall verify operation of all visual indicators on the panel and a visual test of the LCD.
2.2.1.3.1.6 An authorized user shall have the ability to operate or modify system functions including system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
2.2.1.3.1.7 An authorized user shall have the ability to disable/enable devices, zones, actions, timers, and sequences.
2.2.1.3.1.8 An authorized user shall have the ability to activate/restore outputs, actions, sequences, and simulate detector smoke levels. The selection of devices, zones, actions, timers, and sequences shall be made via a descriptive facility structure view removing the need for look up books or entry of numerical addresses. Systems requiring the entry of numeric addresses shall not be considered as equal.
2.2.1.3.1.9 An authorized user shall have the ability to enter time and date, reconfigure an external port for download programming, initiate programming and change passwords.
2.2.1.3.2 An authorized user shall have the ability to test the functions of the installed system.
2.2.1.3.3 Service groups shall facilitate one-man walk testing. Service/test groups shall be capable of being configured with any combination of addressable devices, independent of SLC wiring. It shall be possible to program alternate device responses when the device’s service group is active. Devices not in an active service group shall process all events normally.
2.2.1.3.4 Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.
2.2.1.3.5 SLC loop controller diagnostics shall identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the supervised circuit wiring

of remote addressable modules shall be identified by the device. Systems that provide only device address are not considered equal.

2.2.1.3.6 An authorized user shall have the ability to generate a report history for alarm, supervisory, monitor, trouble including restore activity.

2.2.1.3.7 The panel history shall support storage of up to 20,000 events. History events shall include but not be limited to Event Type, System Command operations, date and time of the event. Reports shall be displayed locally on the panel LCD display, printed to a system printer, reviewed through a web browser and support exporting to .xml file format.

2.2.1.3.8 To enhance forensic examination of history, the system shall support the ability to store the FIFO event history log into a separate region of the database, not impacted by the FIFO operation of events preventing overwriting during forensic examination of an incident. Placing an archive of the history into a separate region of the database shall not interrupt FIFO of the main history or erase any portion of the main history.

2.2.1.3.9 Both FIFO history and archived history shall be available for review through the panel LCD display, be printable through the system printer, retrievable through web services interfaces and be exportable as .xlm formatted file.

2.2.1.3.10 Web browser-based history shall be easily sorted by history for today, history from yesterday, history this week, history last week, history this month, history last month, history this year, history last year, and in combinations.

2.2.1.3.11 System reports shall provide a detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.

2.2.1.3.12 The system shall support multiple printers on the network, printers may be configured for event printing, reports printer or a combination of tasks. Printing of reports and events shall be supported across the entire fire panel network initiated from any LCD user interface point on the network. There must be a method to cancel a report while printing.

2.2.1.3.13 The system shall support printer connections to a panel, or remote annunciators as required by the specific project requirements.

2.2.1.3.14 Printing shall support alarm event high lighting by symbolic character on monochrome printers.

2.2.1.3.15 The system shall support single button press printing to configured printers of an active event queue.

2.2.1.3.16 Remote connection to the panel shall be by interconnection between the owner’s existing TCP/IP network and the native fire panel IP network equipment supplied under this contract as described elsewhere in this specification.

2.2.1.3.17 Fire panel remote connections shall include Cybersecurity measures that meet or exceed FIPS PUB 197.

2.2.1.3.18 The system shall not use easily removable devices, such as SD cards or external memory storage for system critical information including programming and project files storage.

2.2.1.3.19 Security relevant information, such as: failed login attempts, failed unauthorized accesses, and user modification shall be logged to panel history. Unsuccessful authentication attempts shall not leak information regarding the presence of the system or users.

2.2.1.3.20 The system shall only transmit credentials that are encrypted. The system shall provide for multiple users, roles to ensure proper access by users for the role they perform on the system. All passwords shall use a Cypher Algorithm, password must use a hash, no password or authentication shall be exposed in any format in the system database viewable as plain text. Sensitive information shall not be logged to history or displayed on service tools (eg. passwords, PINs etc.).

2.2.1.3.21 The system shall support all default passwords and pass phrases being changed in order to complete the setup, prior to being operational. This includes SSID passphrases, default accounts, admin accounts, etc.

2.2.1.3.22 No special software or hardware shall be required remotely to retrieve reports; report shall be accessed through the use of a web browser so that any device supporting a web browser may be used.

2.2.1.3.23 Proper authentication shall be required to access the system with a web browser.

2.2.1.3.24. An authorized user shall have the ability to display/report the condition of addressable analog detectors. Reports shall include device address, device type, percent obscuration, and maintenance indication. The maintenance indication shall provide the user with a measure of contamination of a device upon which cleaning decisions can be made.

2.2.1.4 Programmability

2.2.1.4.1 Windows-based Configuration Utility (CU) shall be used to create the site-specific system programming. The utility shall facilitate programming of any input point to any output point. The utility shall allow customization of fundamental system operations using initiating events to start actions, timers, sequences, and logical algorithms.

2.2.1.4.2 Zoning of initiation devices.

2.2.1.4.3 Initiation of events by time of day, day of week, day of year.

2.2.1.4.4 Initiation of events by matrix groups (X-Y coordinate relationships) for releasing systems.

2.2.1.4.5 Initiation of events using OR, AND, NOT and counting functions.

2.2.1.4.6 Prioritizing system events.

2.2.1.4.7 Programmable activation of detector sounder bases by detector, groups of bases, or all bases.

2.2.1.4.8 Directing selected device messages to specific panel annunciators

2.2.1.4.9 Detector sensitivity selection by time of day

2.2.1.4.10 Support of 256 Central Monitoring Station accounts and directing selected device messages to any one of ten Central Monitoring Stations.

2.2.1.4.11 Support for event driven Email notifications.

2.2.1.4.12 Support for event driven SMS notifications via SMTP servers.

2.2.1.4.13 The configuration utility shall time and date stamp all changes to the site-specific program and shall facilitate program versioning and shall store all previous program version data. The utility shall provide a compare feature to identify the differences between different versions of the site-specific program.

2.2.1.4.14 The configuration utility shall be capable of generating reports which detail the configurations of all fire alarm panels, addressable devices and their configuration settings, including generating electrical maps of the addressable device SLCs.

2.2.1.4.15 The configuration utility shall support the use of bar code and QR code readers to expedite electronic addressing and custom programming functions.

2.2.1.4.16 Please refer to the *General System Description Section* for this project's site-specific system operating requirements.

2.2.1.4.17 The fire alarm control panel shall be an EDWARDS EST4 and support components in an appropriately sized enclosure.

2.2.2 Power Supply

2.2.2.1 System power supply(s) shall be a high efficiency switched mode design providing multiple supervised power limited 24 VDC output circuits as required by the panel and external loads fed by the panel. Initial power supply loading shall not exceed 80% of power supply capacity in order to allow for future system expansion.

2.2.2.2 Each system's power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

2.2.2.3 It shall be possible to parallel system power supplies to increase capacity or to provide redundant operation.

2.2.2.4 Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functionality.

2.2.2.5 All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

2.2.2.6 All standby batteries shall be continuously monitored by the power supply. The power supply shall be able to perform an automatic load test of batteries and indicate a trouble condition if the batteries fall outside a predetermined range. Power supplies shall incorporate the ability to adjust the charge rate of batteries based on ambient temperatures. The power supply shall automatically disconnect the battery before low voltage damages the battery. Low battery and disconnection of battery power supply conditions shall immediately be annunciated as battery trouble and identify the specific power supply(s) affected.

2.2.2.7 Batteries shall utilize sealed lead acid chemistry. Initial battery capacity shall provide 125% of calculated capacity requirements in order to allow for future system expansion.

2.2.2.8 All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 70 and NFPA 72. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside each control panel the disconnect serves.

2.2.2.9 The power supply shall be an EDWARDS 4-PPS/M series.

2.2.3 User Interface

2.2.3.1 Panel LCD and Common Controls

2.2.3.1.1 The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the facility.

2.2.3.1.2 Each fire alarm control panel shall be capable of supporting a backlit color LCD display. The display on each system panel shall be configurable to display the status of any and/or all combinations of alarm, supervisory, trouble, monitor, or service group event messages on the network. Each LCD display on the system shall be capable of being programmed to allow control functions of any combination of panels on the entire network. All panel touch screen LCD displays shall use resistive technology, be a minimum of 5.7 inches (144.78 mm) in size and support a minimum of 256K colors. Each display shall support the display of a minimum of 8 events simultaneously without the need to scroll or make manual selections at the display.

2.2.3.1.3 The LCD display shall provide a minimum of 10 separate event queues to minimize operator confusion by automatically categorizing event types, the queues shall include but not be limited to Alarm, Emergency, Supervisory, Disables/Bypasses/Test, Ground Fault, Monitor, and Fire Phone call in. To further enhance the usability only queues with events shall be displayed, queues without active events shall not be displayed. It shall be possible to scroll through and view specific alarm, trouble, supervisory and monitor events separately. Having to scroll through a mixed list of event types shall not be considered as equal. The total number of active and disabled events by type shall be displayed. Visual indication shall be provided of any event type that has not been acknowledged or viewed. It shall be possible to customize the designation of all user interface LEDs and Switches for local language requirements.

2.2.3.1.4 The display shall support Instructional text messages by event of up to 2,000 characters each.

2.2.3.1.5 Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device.

2.2.3.1.6 The LCD display shall contain the following system status:

2.2.3.1.6.1. System Power Indicator
2.2.3.1.6.2. System Test Indication
2.2.3.1.6.3. System CPU Fail Indicator
2.2.3.1.6.4. Ground Fault Indication
2.2.3.1.6.5. Disabled Points Indication
2.2.3.1.6.6. System Normal Indication
2.2.3.1.6.7. System Common Alarm Indicator
2.2.3.1.6.8. System Common Trouble Indicator
2.2.3.1.6.9. System Supervisory Indication
2.2.3.1.6.10. System Common Monitor Event Indication
2.2.3.1.6.11. Call-In Indication
2.2.3.1.6.12. Request for Control Indication
2.2.3.1.6.13. Emergency Indication

2.2.3.1.7 The LCD display shall contain the following system switch/indicators. Each common control switch shall be tactile in nature and shall not be part of the touch screen display area. The switches shall be prominent from the display face allowing ease of operation, be provided with color coded ring as described below and be local language/dialect adaptable. Confirmation of user switch activation shall be provided by illumination of the accompanying indicator. The switches shall support customization by individual LCD location on the project. Switch designation and operation shall be as per the plans or shall be as follows:

2.2.3.1.7.1 Panel Silence Switch with black color coding and visual indicator
2.2.3.1.7.2. Drill Switch with white color coding and visual indicator.
2.2.3.1.7.3. System Alarm Silence Switch with red color coding and visual indicator
2.2.3.1.7.4. System Reset Switch with green color coding and visual indicator.

2.2.3.1.8 The LCD display shall contain the following system function Buttons.

2.2.3.1.8.1. System Event Message Queue Scroll Bar.
2.2.3.1.8.2. Details Button (provides an additional 2000-character instructional text message about the device highlighted by the operator.)
2.2.3.1.8.3. Action Bar

2.2.3.1.9 The LCD display shall contain the following project display items:

2.2.3.1.9.1. Graphical tree representation of the project
2.2.3.1.9.2 Color coded counters displaying the number of active Alarms, Emergency, Supervisory, Disable, Trouble, Ground fault, events shall be provided. Counters shall only display when events are present for the queue type and shall not be displayed when there are no active events.
2.2.3.1.9.3 Time and date. The date shall be selectable as to the displayed order of its elements and shall be displayed as MM/DD/YYYY.
2.2.3.1.9.4 Events displayed on the LCD shall show the event type with time stamp and text describing the location of the device.

2.2.3.1.10 The system Color Touchscreen LCD display shall be an EDWARDS model 4-LCD series.

2.2.3.2 LEDs and Switches

2.2.3.2.1 A modular series of switches and LED indicators shall be available to customize the fire alarm control panel operation in accordance with this specification. All LED and switch functions shall be software programmable. Switches shall be configurable for momentary, maintained, toggle, or “exclusive or” operation as required by the application. Any group of switches may use “exclusive or” in combination of 2 switches

2.2.3.2.2 LEDs shall be dynamically programmable for slow flash, fast flash or steady operation. LED/Switch modules shall be capable of mounting in any available fire panel or annunciator inner door position. All LED/Switch modules shall be supervised. All individual indicator LED location shall be configurable for color,

including Red, Yellow, Blue, Green or White to facilitate identification from a distance and maximize display location usage. The LED/Switch modules shall provide buttons that are silicon rubber to provide tactile feedback for a button press. LEDs adjacent to each button will provide illuminated visual feedback for a button press. The LED/Switch modules provide insert pockets with room by each LED/Switch location for custom function identification. The LED/Switch modules insert pocket provides room at the top to identify the function of the module's indicators and buttons as a group. The inserts shall be printable from a LaserJet printer, support the use of background colors to accentuate switch grouping and mount under a protective membrane.

2.2.3.2.4 The LED/Switch modules shall be EDWARDS model, 4-24L, 4-24L12S, 4-24L18S, 4- 24L24S.

2.2.3.3 Audio Annunciation and Control

2.2.3.3.1 Provide emergency audio as part of the fire alarm control. The emergency audio shall contain a paging microphone, pre-recorded messages, and zoned amplifiers capable of delivering multi-channel audio messages. The system shall support a minimum of 100 audio channels. Transmission of audio shall be over the same data network cabling as the fire panel data. The network cabling shall be a dedicated single copper twisted pair to remote parts of the facility.

2.2.3.3.2 For systems requiring multiple locations for paging control, the ability to Request/Grant/Deny page privileges shall be supported in any combination. Priorities based on wiring locations are not considered equal. Priorities shall be configured in software for operational needs between Autonomous Control Units (ACU), Central Control Station (CCS) and Local Operators Consoles (LOCs). The system shall support a minimum of 9 priority levels.

2.2.3.3.3 Each panel shall store digitally up to 750 minutes of pre-recorded audio message files without the need to add additional memory storage devices. These messages shall be automatically played in various areas of a facility under program control. The system shall have the capacity to store up to 250 individual audio messages. The system shall support up to 100 channels of audio. An audio channel shall support up to 250 individual messages. Each panel shall support simultaneous playback of seven (7) different message channels in addition to a live page message. Systems that cause signaling devices to go silent while performing any signaling functions will not be accepted. The system shall support repeat counts of audio messages and stacking of audio messages in a FIFO configuration.

2.2.3.3.4 During non-alarm conditions, each panel shall supervise its amplifiers, inter-panel networking shall be supervised, and audio hardware shall be supervised providing total audio path supervision.

2.2.3.3.5 Each FACP containing an audio amplifier or audio source connection shall contain its locally required pre-recorded messaging onboard. Should a fire AND a control network system failure occur, the programmed pre-recorded messages shall be played from the locally stored data. Sending pre-recorded messages across a network or external panel interconnection shall not be considered equal. Should local pre-recorded audio be unavailable, the local amplifiers shall provide an integral backup 1 KHz temporal tone generator which shall operate in the event primary audio signals are lost and the amplifier is instructed to broadcast alarm information. The amplifier shall support an alert pattern distinct from the evacuation temporal tone pattern.

2.2.3.3.6 The system shall provide color LCD display to direct live paging messages as follows in any combination:

2.2.3.3.7 "All Call" to direct the page messages to wide areas in the facility, overriding all other messages and tones. "All Call" shall automatically, without user intervention, not affect signaling in areas defined as 'other' nor active Mass Notification areas.

2.2.3.3.8 "Page to Balance of Building" to direct page messages to the areas in the facility NOT receiving either the evacuation area or alert area messages.
2.2.3.3.9 "Page to Other" shall provide for specific paging in special case areas, as an example stairwells.
2.2.3.3.10 The system shall support selection, in any combination, of the above audio controls. Systems that require single audio control selection requiring paging messages to be repeated for different areas shall not be considered as equal.
2.2.3.3.11 The system shall provide individual discrete switches for each page zone selection. Each switch shall have two LEDs, a Page Active LED blue in color and Page Zone Trouble LED yellow in color. Each switch shall be supplied with a printed customer label describing the page zone, handwritten labels will not be accepted.
2.2.3.3.12 The system shall provide zone audio activity indicators, each indicator shall flash slow for alert messages, flash fast for EVAC massages and turn on steady for paging messaging> .
2.2.3.3.13 The system shall provide configurable pre-announced tones for emergency and non- emergency paging. The tones shall be separate and differentiated between the two operations.
2.2.3.3.14 The system shall automatically deliver a configurable pre-announced tone or message when the emergency operator presses the microphone PTT key for each premise/building. A 'ready to page' LED shall flash during the pre-announce phase and turn steady when the system is ready for the user's page delivery. The system shall include a page deactivation timer which activates for 10 seconds when the emergency user releases the microphone talk key. Should the user subsequently press the microphone key during the deactivation period a page can be delivered immediately. Should the timer complete its cycle the system shall automatically restore emergency signaling and any subsequent paging will be preceded by the pre-announced tone.
2.2.3.3.15 Each paging microphone assembly shall include a three-color VU meter display indicating to the emergency operator their voice level.
2.2.3.3.16 The system shall support line level input as an audio source. The line level input to output relationship shall be controlled through programming and it shall be possible for the input to be programmed to any output on any system channel. The system shall assign priorities to audio channels based on system programming.
2.2.3.3.17 The fire alarm control panels shall support remote cabinets with zoned amplifiers to receive, amplify and distribute live voice paging, line level input and locally stored pre- recorded messages through speakers over supervised circuits.
2.2.3.3.18 The system shall provide confirmation of audio channels status for pre-recorded messages, when streaming live audio or from external inputs.
2.2.3.3.19 The emergency audio control shall consist of EDWARDS 4-MIC, 4-LCDAUDTEL series, 4-24L series4-LCD series.

2.2.3.4 Remote Microphone

2.2.3.4.1 Remote microphones shall be included in the remote annunciators as indicated on the drawings.
2.2.3.4.2 The remote microphone shall facilitate live page announcements over the ACU/FACP system from locations distant from the ACU/FACP.
2.2.3.4.3 The remote microphone shall feature a Push-to-Talk switch; ready to page LED, and three-color VU meter giving indication of the operator's voice level.
2.2.3.4.4 The remote microphone shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the ACU/FACP or listed auxiliary power supply, ensuring a reliable and monitored power source.
2.2.3.4.5 Audio from the remote microphone shall be processed and sent to paging areas based on programming or from page selection via color LCD display. Audio

shall be routed to other areas via the systems network infrastructure cabling, having to pull additional communications cables to support remote microphones is not acceptable.

2.2.3.4.6 The remote microphone shall be an EDWARDS model 4-MIC.

2.2.3.5 Reports

2.2.3.5.1 The system shall provide the operator with system reports that give detailed descriptions of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD and via a standard browser. Reports provided by web browsers shall be capable of being saved for archiving and detailed analysis. Reports through web browser connection shall require proper authentication. Reports retrieved from the LCD shall be capable of being printed on any system printer configured for the purpose.

2.2.3.5.2 The system shall provide a report that gives a sensitivity listing of all detectors that have less than 80% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector. The systems shall provide graphical representations of Sensitivity and Dirty levels in reports displayed on a system LCD or web browser for quick recognition of device status. Systems that provide text only reports of this type shall not be considered equal.

2.2.3.5.3 When addressable CO detectors are installed, performing a “sensitivity” check from the panel shall report the approximate number months of CO sensor life remaining. The systems shall provide graphical representations of CO sensor life remaining in reports displayed on a system LCD or web browser for quick recognition of device status. Systems that provide text only reports of this type shall not be considered equal.

2.2.3.5.4 The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system.

2.2.3.5.5 The system shall provide a report that gives a chronological listing of at least the last 10,000 system events in addition a minimum of 10,000 Alarm events shall be captured and stored. The system shall support capturing of 10,000 most recent events, this captures an incident history which cannot be overwritten until history is cleared or an additional most recent events capture is made. Alarm events shall include color coding when viewed on the Panel LCD, or remotely via a web browser.

2.2.3.5.6 The system shall support History report retrieval that provides All History event or filtering by Alarm, or Supervisory, or Trouble or test History. The History report via web browser shall allow filtering by specified start and end times and dates.

2.2.3.5.7 System reports accessed through a browser shall support the use of Internet Explorer, Edge, Chrome, Safari, and Firefox on any device that supports the browser. Systems that require the use of a specific device type or AP for accessing reports shall not be considered equal.

2.2.4 Signaling Line Circuits

2.2.4.1 Intelligent Addressable Device

2.2.4.1.1 The signaling line circuit connecting panels/nodes to intelligent addressable devices including, detectors, monitor modules, control modules, isolation modules and notification circuit modules shall be Class B. All signaling line circuits shall be supervised and power limited.

2.2.4.1.2 When the addressable devices on a signaling line circuit cover more than one designated fire/smoke compartment, a wire-to-wire short on the circuit shall not affect the operation of the addressable devices in other fire/smoke compartments.

2.2.4.1.3 Each SLC shall support 125 addressable detector addresses and 125 module addresses. The SLC shall support 100% of all addressable devices in

alarm and provide support for a 100% compliment of detector isolator bases. Initial circuit loading shall not exceed 80% in order to allow for future system expansion.

2.2.4.1.4 T-taps (branching) shall be permitted on Class B circuits. Where possible, the devices installed at the end of each branch should be easily accessible for troubleshooting, e.g. a pull station at normal mounting height. No more than 10% or 12 T-taps permitted. Isolation Modules are excluded.

2.2.4.1.5 The addressable device SLC module shall be UL Listed for use with code compliant, electrically sound existing wiring.

2.2.4.1.6 Each intelligent addressable device shall transmit information about its location with respect to other devices on the circuit. This information shall be used to create an “As- Built” wiring diagram as well as provide enhanced supervision of a device’s physical location. The device message and programmed system output function shall be associated with the device’s location on the SLC circuit location and not a device address.

2.2.4.1.7 The SLC module shall allow replacement of “same type” devices without the need to address and reload the “location” parameters on replacement devices. Mapping shall be enabled, no exceptions.

2.2.4.1.8 The SLC/Panels shall notify the user when un-programmed devices are detected on the SLC circuit. The SLC/Panels shall notify the user when the wrong device type is installed at a location configured for a different device type on the SLC circuit.

2.2.4.1.9 Should an SLC Controller CPU fail to communicate, the SLC circuit shall go into the stand-alone mode. The circuit shall be capable of producing a loop alarm if an alarm type device becomes active during stand-alone mode to enhance system integrity.

2.2.4.1.10 The addressable device signaling line circuit module shall be an EDWARDS 3- SSDC2.

2.2.5 Notification Appliance Circuits

2.2.5.1 Notification Appliance Circuits

2.2.5.1.1 General

2.2.5.1.1.1 All notification circuits shall be supervised and power limited. Non-power limited circuits are not acceptable. All notification appliance circuits shall be Class A.

2.2.5.1.1.2 Initial circuit loading shall not exceed 80% in order to allow for future system expansion.

2.2.5.1.2 24 VDC Notification Appliance circuits

2.2.5.1.2.1 Notification appliance circuits shall have a minimum circuit output rating of 2 amps @ 24 VDC.

2.2.5.1.2.2 24VDC NACs shall be polarized and provide both strobe synchronization and a horn silence signal on a single pair of wires.

2.2.5.1.3 Audio Notification Appliance Circuits

2.2.5.1.3.1 Audio notification appliance circuits shall be polarized and have a minimum circuit output rating of 50 watts @ 25V audio, and 35 watts @ 70V audio.

2.2.5.2 Audio Amplifiers

2.2.5.2.1 Provide emergency audio as part of the main fire alarm control panel. The emergency audio shall contain a paging microphone and zoned amplifiers capable of delivering multi-channel audio messages. The system shall support a minimum of 100 audio channels. Transmission of live paging audio shall be over the same data network cabling as the fire panel data. The network data transmission shall be over a dedicated single copper pair cabling to remote parts of the facility. Pre-recorded messages shall be stored locally at each panel, to

reduce the impact of wire faults during a fire event. Transmission of pre-recorded audio across the network for notification during an event is not acceptable.

2.2.5.2.2 For systems requiring multiple locations for paging, the ability to Request/Grant/Deny page privileges shall be supported. Priorities shall be configured in software covering the operational priorities between Autonomous Control Units (ACU), Emergency Communication Control Unit (ECCU) and Local Operators Consoles (LOCs). As a minimum the system shall consist of: Local Page, Emergency Communication, Evacuation, Alert, Auxiliary, Other and General Signaling. Channels shall support hierarchical operation and be controllable through system programming. The audio system shall also provide Elevator, Stairwell and Auxiliary signaling. Systems that cause signaling devices to go silent while performing any signaling functions will not be accepted. The system shall support repeat counts of audio messages and stacking of audio messages in a FIFO configuration.

2.2.5.2.3 The audio system zoned amplifiers must be able to operate 25 VRMS or 70 VRMS speakers and be power limited and protected from short circuit conditions on the audio circuit. The amplifier output must be power limited and wired in a Class B configuration. The amplifiers shall source pre-recorded messages locally and shall not have to rely on network communications to receive pre-recorded messaging. Should local audio be unavailable the amplifiers shall provide an integral backup 1000 Hz temporal (3-3-3) tone generator evacuation notification and 20PPM for alert notification which shall operate in the event primary audio signals are lost and the amplifier is instructed to broadcast alarm information.

2.2.5.2.4 Amplifiers shall also include a 24 VDC notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable.

2.2.5.2.5 Audio amplifiers shall be EDWARDS 3-ZA series.

2.2.6 Initiating Device Circuits

2.2.6.1 Initiating Device Circuits

2.2.6.1.1 Conventional (2-wire) initiating device circuits monitoring manual fire alarm stations, smoke, and heat detectors, waterflow switches, valve supervisory switches, fire pump functions, and air pressure supervisory switches shall be .

2.2.6.1.2 Initiating device circuits shall be configurable for latched or non-latched operation and configurable to initiate alarm, supervisory or monitor events.

2.2.6.1.3 End-of-line resistors for conventional initiating device circuits shall be covered with insulated tubing, terminated with ring lugs, and display a UL label.

2.2.7 Off Premises Communications

2.2.7.1 DACT

2.2.7.1.1 The system shall provide off-premises communications capability using a Digital Alarm Communications Transmitter (DACT) for sending system events to multiple Central Monitoring Station (CMS) receivers.

2.2.7.1.2 The transmission to the Central Station shall be over cellular communication.

2.2.7.1.3 The system shall provide the CMS(s) with point identification of system events using Contact ID (SIA DC-05) or SIA DCS protocols.

2.2.7.1.4 The dialer shall support up to 255 individual accounts and to send account information to eight (8) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system design.

2.2.7.1.5 In the event of the fire alarm panel CPU failure during a fire alarm condition, the local DACT degrade mode shall transmit a general fire alarm signal to the CMS.

2.2.7.1.6 The DACT shall be an EDWARDS 3-MODCOM(P).

2.2.7.1.7 The system shall provide off premises communications capability using a cellular Digital Alarm Communications Transmitter (Cell/DACT) for sending system events to multiple Central Monitoring Station (CMS) receivers over a Cellular network.

2.2.7.1.8 Any cellular communication hardware used for this purpose shall be UL listed and compatibility listed for use with the fire panel. Third party cellular equipment is acceptable but generic compatibility statements are not acceptable, only devices shown in the panels UL controlled compatibility list shall be accepted.

2.3 REMOTE BOOSTER POWER SUPPLY

2.3.1 Remote Booster Power Supply

2.3.1.1 Install Remote NAC Power Supplies (boosters) at the locations shown on the drawings, as required, to minimize NAC voltage drops. Remote NAC power supplies shall be treated as peripheral NAC devices and shall not be considered fire alarm control units.

2.3.1.2 The NAC power supplies shall be fully enclosed in a surface mounted steel enclosure with hinged door and cylinder lock and finished in red enamel. Door keys shall be identical to FACP enclosure keys. The enclosure shall have factory installed mounting brackets for additional UL listed fire alarm equipment within its cabinet. Enclosures shall be sized to allow ample space for interconnection of all components and field wiring, and up to 10AH batteries. The enclosure shall have provisions for an optional tamper switch. All FACP addressable control modules required to initiate the required NAC power supply output functions shall be installed within the NAC power supply enclosure.

2.3.1.3 Remote NAC power supply input circuits shall be configurable as Class B supervised inputs or for connection to any 6 to 45 VDC initiation source.

2.3.1.4 Remote booster power supplies shall provide four (4) synchronized Class B or two (2) Class A, supervised and power limited, 24VDC filtered and regulated Notification Appliance Circuits (NACs). Each NAC output shall be configurable as a continuous 24Vdc auxiliary power output circuit. The booster power supply shall be capable of a total output of 10 amps.

2.3.1.5 The power supply NACs shall be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. It shall be possible to configure the NACs to follow the main FACP NAC or activate from intelligent addressable synchronized modules. All visible audible NACs within the facility shall be synchronized.

2.3.1.6 Upon failure of primary AC power, the remote power supply shall automatically switch over to secondary battery power without losing any system functions. It shall be possible to delay the reporting of an AC power failure for up to 6 hours. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately be annunciated locally as battery trouble. All power supply trouble conditions (DC power failure, ground faults, low batteries, and IDC/NAC circuit faults) shall identify the specific remote power supply affected at the main FACP. All power supply trouble conditions except loss of AC power shall report immediately. Interconnecting NAC Booster power supplies in a manner which prevents identification of an individual power supply trouble shall not be considered as an equal.

2.3.1.7 The remote booster power supply shall be capable of recharging up to 24AH batteries to 70% capacity in 24 hours maximum. Batteries provided shall be sized to meet the same power supply performance requirements as the main FACP, as detailed elsewhere in this specification.

2.3.1.8 All AC power connections shall be to the building's designated dedicated emergency electrical power circuit. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside each remote NAC power supply the disconnect serves.

2.3.1.9 The remote NAC power supplies shall be EDWARDS model BPS/APS series.

2.4 PERIPHERAL COMPONENTS

2.4.1 Addressable

2.4.1.1 Detectors

2.4.1.1.1 Optical Photoelectric Detector

2.4.1.1.1.1 Provide analog/addressable optical (photoelectric) smoke detectors at the locations shown on the drawings.

2.4.1.1.1.2 When mounted in a sounder base, the detector shall initiate a temporal 3-3-3 when smoke is detected.

2.4.1.1.1.3 The optical smoke detector shall be suitable for direct insertion into air ducts up to 3 feet (91.44 cm) high and 3 feet (91.44 cm) wide with air velocities up to 4,000 ft/min. (0- 22.22 yard (20.32 meter)/sec) without requiring specific duct detector housings or supply tubes.

2.4.1.1.1.4 The optical detector shall be listed as a multi criteria detector without the use of other sensing elements, and the use of fixed end of life sensing components is not acceptable. Each optical smoke detector shall be capable of rejecting nuisance sources and detect smoke in the full life safety window of 0.5% to 4.36% obscuration/foot. Shall be listed to UL 268 7th edition. Detectors that have to operate in a special application mode that cannot achieve the full 0.5% to 4.36% life safety window shall not be considered equal.

2.4.1.1.1.5 Each smoke detector shall be individually programmable to operate at any one of five (5) sensitivity settings. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. The detector shall be able to differentiate between a long-term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel. It shall be possible to automatically change the sensitivity of individual intelligent addressable smoke detectors for day and night (alternate) periods.

2.4.1.1.1.6 Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

2.4.1.1.1.7 The photoelectric smoke detector shall be an EDWARDS SIGA-OSD.

2.4.1.1.2 Duct Smoke Detector

2.4.1.1.2.1 Provide intelligent low profile photoelectric duct smoke detectors / remote test switches at the locations shown on the drawings.

2.4.1.1.2.2 The intelligent duct smoke detector shall operate in ducts having from 100ft/min to 4,000ft/min air velocity. The detector shall be suitable for operation over a temperature range of -20 to 158F° and offer a harsh environment gasket option. The detector shall utilize an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten (10) feet. The design of the detector shall permit sampling tube installation from either side of the detector and permit sampling tube installation in 45- degree increments to ensure proper alignment with duct airflow. Drilling templates and gaskets to facilitate locating and mounting the housing shall be provided.

2.4.1.1.2.3 The intelligent duct smoke detector shall obtain information from a photoelectric sensing element. The detector shall be able to differentiate

between a long-term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel.

2.4.1.1.2.4 Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

2.4.1.1.2.5 The intelligent duct smoke detector shall provide a form “C” auxiliary alarm relay rated at 2amps @ 30Vdc. The position of the relay contact shall be supervised by the control panel software. Operation of the relay shall be controlled either by its respective detector processor or under program control from the control panel as required by the application. Detector relays not capable of programmed operation independent of the detector’s state shall not be considered as equal. The detector shall be equipped with a local magnet-activated test switch.

2.4.1.1.2.6 Each duct detector shall be installed and testing in accordance with manufacturer’s instructions, including pressure differential and, velocity testing. Test results shall be submitted to the owner.

2.4.1.1.2.7 Remote test switches/LED indicators shall be provided within sight of the detector, at locations indicated on the drawings.

2.4.1.1.2.8 The Intelligent Photoelectric Duct Smoke Detector shall be an EDWARDS model SIGA-DDOS.

2.4.1.1.2.9 The remote key operated test switch / LED shall be an EDWARDS model SD- TRK

2.4.1.1.2.10 HVAC units Duct Detectors shall be controlled by EDWARDS SIGA-DDOS Duct Detectors.

2.4.1.1.2.11 Fire Smoke Dampers shall be controlled from EDWARDS SIGA-DDOS Duct Detector.

2.4.1.1.3 Duct Mounting Plate

2.4.1.1.3.1 Where addressable smoke detectors are directly mounted on a low velocity ducts up to 3 feet (91.44 cm) high x 3 feet (91.44 cm) wide, provide factory mounting plate assemblies to facilitate mounting the detectors. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish. The detector mounting plate shall support an addressable detector along with a standard, relay or isolator detector mounting base.

2.4.1.1.3.2 The detector mounting plate shall be an EDWARDS SIGA-DMP.

2.4.1.1.4 Fixed Heat Detector

2.4.1.1.4.1 Provide intelligent fixed temperature heat detectors at the locations shown on the drawings.

2.4.1.1.4.2 The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The detector shall utilize a low mass thermistor heat sensor and operate at a nominal fixed temperature alarm point rating of 135oF (57oC). The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of thermistor data. Systems using central intelligence for alarm decisions shall not be considered as equal.

2.4.1.1.4.3 The heat detector shall be rated for ceiling installation at a minimum of 50 feet (1524 cm) centers and also be suitable for wall mount applications.

2.4.1.1.4.4 The Intelligent fixed temperature detector shall be an EDWARDS SIGA-HFD.

2.4.1.1.5 Rate of Rise Detector
2.4.1.1.5.1 Provide intelligent combination fixed temperature / rate-of-rise heat detectors at the locations shown on the drawings.
2.4.1.1.5.2 The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The detector shall utilize a low mass thermistor heat sensor and operate at a nominal fixed temperature alarm point rating of 135oF and at a temperature rate-of- rise alarm point of 15oF per minute. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of thermistor data. Systems using central intelligence for alarm decisions shall not be considered as equal.
2.4.1.1.5.3 The heat detector shall be rated for ceiling installation at a minimum of 50 feet (1524 cm) centers and also be suitable for wall mount applications.
2.4.1.1.5.4 The Intelligent combination fixed temperature / rate-of-rise heat detector shall an EDWARDS SIGA-HRD.
2.4.1.1.6 Standard Base
2.4.1.1.6.1 Provide standard detector bases suitable for mounting on either North American 1-gang, 3½ or 4-inch octagon box and 4 inch (101.6 mm) square box, European BESA or 1- gang box.
2.4.1.1.6.2 The bases shall utilize a twist-lock design and provide screw terminals for all field wiring connections.
2.4.1.1.6.3 The base shall contain no active electronics and support all Signature series detector types.
2.4.1.1.6.4 The base shall be capable of supporting a Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.
2.4.1.1.6.5 Removal of the respective detector shall not affect communications with other detectors.
2.4.1.1.6.6 The standard addressable detector base shall be an EDWARDS SIGA-SB or SB4.
2.4.1.1.6.7 The remote LED indicator shall be an EDWARDS SIGA-LED
2.4.1.2 Manual Stations
2.4.1.2.1 Double Action Single Stage
2.4.1.2.2 Provide addressable double action, single stage fire alarm stations at the locations shown on the drawings.
2.4.1.2.3 The manual station shall be suitable for mounting on North American 2-½" (64mm) deep 1-gang boxes and 1 ½ (38mm) deep 4 square boxes with 1-gang covers. If indicated as surface mounted, provide manufacturer's surface back box.
2.4.1.2.4 The fire alarm station shall utilize red polycarbonate construction with molded, raised-letter operating instructions in a contrasting color; shall show visible indication of operation and incorporate an internal toggle switch.
2.4.1.2.5 The manual pull station will have an addressable module integral to the unit.
2.4.1.2.6 The station reset key shall match the control panel key.
Manual pull stations that initiated an alarm condition when opening the unit are not acceptable.
2.4.1.2.8 The addressable double action, single stage manual fire alarm station shall be an EDWARDS SIGA-278.
2.4.1.3 Modules
2.4.1.3.1 General
2.4.1.3.1.1 General Requirements for Intelligent Addressable Heat, Smoke and CO Detectors
2.4.1.3.1.2 Each detector shall contain an integral microprocessor which shall determine if the device is normal, in alarm, or has an internal trouble. The microprocessor’s non-volatile memory shall permanently store the detector’s

serial number, device type and system address. It shall be possible to address each intelligent device without the use of switches. Devices requiring switches for addressing shall not be considered as equal. Memory shall automatically be updated with the hours of operation, last maintenance date, number of alarms and troubles, time of last alarm, and analog signal patterns for each sensing element just before the last alarm.

2.4.1.3.1.3 Each detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

2.4.1.3.1.4 Each addressable detector on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent devices on the signaling line circuit to the control panel, creating an “As-Built” circuit map. The circuit mapping function shall provide location supervision of all intelligent devices on the signaling line circuit. An intelligent detector’s programmed system response functions shall be associated with the detector’s actual location on the signaling line circuit and not with the detector’s address. After system commissioning, detectors improperly installed in the wrong location shall function according to the mapped programmed response for its location on the circuit, not its detector’s address.

2.4.1.3.1.5 A status indicator shall be provided on each detector. Flashing green shall indicate normal operation; flashing RED shall indicate the alarm state. The indicator shall be visible from any direction.

2.4.1.3.1.6 The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced, without the need for reprogramming. The system shall display an off-normal condition until the proper detector type is installed or a change in the device type profile has been made.

2.4.1.3.1.7 Detectors shall be rated for operation in the following environment unless specifically noted:

2.4.1.3.1.7.1 Temperature: 32°F to 120°F (0°C to 49°C)

2.4.1.3.1.7.2 Humidity: 0-93% RH, non-condensing

2.4.1.3.1.8 Detectors with addressing components in the base shall not be considered as equal.

2.4.1.3.1.9 The intelligent detectors shall be EDWARDS Signature Series devices.

2.4.1.3.2 One Input Monitor

2.4.1.3.2.1 Provide addressable single input multifunction modules at the locations shown on the drawings.

2.4.1.3.2.2 The module shall be suitable for mounting on North American 2½” (64mm) deep 1-gang boxes and 1½” (38mm) deep 4” square boxes with 1-gang covers.

2.4.1.3.2.3 Each module shall provide one (1) supervised Class B input circuit configurable as one of the following “personalities.”

2.4.1.3.2.3.1 Normally-Open Alarm Latching (for alarm initiation applications)

2.4.1.3.2.3.2 Normally-Open Alarm Delayed Latching (for waterflow switch applications)

2.4.1.3.2.3.3 Normally-Open Active Non-Latching (for limit switch and monitor applications)

2.4.1.3.2.3.4 Normally-Open Active Latching (for tamper switch and supervisory applications)

2.4.1.3.2.4 Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuit, to the control panel. Single function modules or without individual ground fault detection identification capability shall not be considered as equal.

2.4.1.3.2.5 The Intelligent Single Input Module shall be an EDWARDS SIGA-CT1.

2.4.1.3.3 Two Input Monitor

2.4.1.3.3.1 Provide addressable dual input multifunction modules at the locations shown on the drawings.

2.4.1.3.3.2 The module shall be suitable for mounting on North American 2½" (64mm) deep 1-gang boxes and 1½" (38mm) deep 4" square boxes with 1-gang covers.

2.4.1.3.3.3 Each module shall provide two (2) supervised Class B input circuit configurable as one of the following "personalities."

2.4.1.3.3.3.1 Normally-Open Alarm Latching (for alarm initiation applications)

2.4.1.3.3.3.2 Normally-Open Alarm Delayed Latching (for waterflow switch applications)

2.4.1.3.3.3.3 Normally-Open Active Non-Latching (for limit switch and monitor applications)

2.4.1.3.3.3.4 Normally-Open Active Latching (for tamper switch and supervisory applications)

2.4.1.3.3.4 Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuits, to the control panel. Single function modules or without individual ground fault detection identification capability shall not be considered as equal.

2.4.1.3.3.5 The Addressable Dual Input Module shall be an EDWARDS SIGA-CT2 or MCT2.

2.4.1.3.4 Notification Circuit

2.4.1.3.4.1 Provide addressable notification appliance circuit modules at the locations shown on the drawings.

2.4.1.3.4.2 The module shall be suitable for mounting in North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.

2.4.1.3.4.3 The addressable NAC module shall provide one (1) supervised Class B notification appliance circuit.

2.4.1.3.4.4 The NAC control module shall be configurable for the following operations:

2.4.1.3.4.5. 24 VDC synchronized NAC circuit, 2 amps @ 24 VDC.

2.4.1.3.4.6. Audio notification circuit 25Vrms @ 50 watts or 70 Vrms @ 35 watts

2.4.1.3.4.7. Firefighter's Telephone control with ring tone

2.4.1.3.4.8. The addressable notification appliance circuit module shall be an EDWARDS SIGA-CC1(S) or MCC1(S)

2.4.1.3.5 Isolation Module

2.4.1.3.5.1 Provide addressable isolator modules at the locations shown on the drawings.

2.4.1.3.5.2. The module shall be suitable for mounting on North American 2½" (64mm) deep 1-gang boxes and 1½" (38mm) deep 4" square boxes with 1-gang covers.

2.4.1.3.5.3 In the event the Class A signaling line circuit on which the intelligent isolator module is installed is shorted, each module shall open the SLC. Isolator modules shall then sequentially reconnect the isolated circuit segments until only the segment with the short is left out of the circuit, leaving the balance of the circuit operational.

2.4.1.3.5.4 SLC isolation shall be provided for each floor or protection zone of building.

2.4.1.3.5.5. The addressable Isolator Module shall be an EDWARDS SIGA-IM2.

2.4.1.3.6 Universal Modules

2.4.1.3.6.1 Provide intelligent universal Class A/B multifunction modules at the locations shown on the drawings.

2.4.1.3.6.2 The module shall be suitable for mounting on North American 2½" (64mm) deep 2-gang boxes and 1½" (38mm) deep 4" square boxes with 2-gang covers.

2.4.1.3.6.3 Each universal module shall be configurable as one of the following "personalities."

2.4.1.3.6.3.1 Two (2) supervised Class B Normally-Open Alarm Latching. (for alarm initiation applications)

2.4.1.3.6.3.2 Two (2) supervised Class B Normally-Open Alarm Delayed Latching. (for waterflow switch applications)

2.4.1.3.6.3.3 Two (2) supervised Class B Normally-Open Active Non-Latching. (for limit switch and monitor applications)

2.4.1.3.6.3.4 Two (2) supervised Class B Normally-Open Active Latching. (for tamper switch and supervisory applications)

2.4.1.3.6.3.5 One (1) form "C" dry relay contact rated at 2 amps @ 24 Vdc. (for circuit control applications)

2.4.1.3.6.3.6 One (1) supervised Class A Normally-Open Alarm Latching. . (for alarm initiation applications)

2.4.1.3.6.3.7 One (1) supervised Class A Normally-Open Alarm Delayed Latching. . (for waterflow switch applications)

2.4.1.3.6.3.8 One (1) supervised Class A Normally-Open Active Non-Latching. (for limit switch and monitor applications)

2.4.1.3.6.3.9 One (1) supervised Class A Normally-Open Active Latching. . (for tamper switch and supervisory applications)

2.4.1.3.6.3.10 One (1) supervised Class A 2-wire Smoke Alarm Non-Verified. (for alarm initiation applications)

2.4.1.3.6.3.11 One (1) supervised Class B 2-wire Smoke Alarm Non-Verified. (for alarm initiation applications)

2.4.1.3.6.3.12 One (1) supervised Class A 2-wire Smoke Alarm Verified (for alarm initiation applications)

2.4.1.3.6.3.13 One (1) supervised Class B 2-wire Smoke Alarm Verified(for alarm initiation applications)

2.4.1.3.6.3.14 One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.(for occupant notification applications)

2.4.1.3.6.3.15 One (1) supervised Class B Signal Circuit, 24Vdc @ 2A. .(for occupant notification applications)

2.4.1.3.6.4 Each module shall identify, and report ground faults, opens and shorts associated with its supervised input / output circuits, by device address, to the control panel. Single function modules or without individual ground fault detection identification capability shall not be considered as equal.

2.4.1.3.6.5 The Universal Class A/B Module shall be an EDWARDS SIGA-UM.

2.4.2 Notification Appliances

2.4.2.1 Low Profile

2.4.2.1.1 Speaker-Strobe-Wall

2.4.2.1.1.1 Provide low profile wall mounted speaker-strobes at the locations shown on the drawings.

2.4.2.1.1.2 For flush mount, the low-profile speaker-strobes shall mount in a North American 4" x 2 1/8" square electrical box, without trims or extension

rings, and protrude less than 1” from the finished wall. The word ALERT shall be prominently displayed on the housing.

2.4.2.1.1.3 For surface mount, the low-profile speaker-strobes shall mount in an Edwards G4WSB back box. Any other approved back box must match the color of the surroundings and color of exposed raceway.

2.4.2.1.1.4 The speaker output shall be switch selectable from the following available settings: 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 feet (304.8 cm) when measured in reverberation room per UL 464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

2.4.2.1.1.5 The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 110cd. Selected strobe rating shall be visible when the speaker-strobe is in its installed position. Amber lens strobes shall be available with outputs of 12/24/60/88cd. Light shall be evenly distributed throughout the required volume using cavity and mask “Full Light” technology to prevent hot spots. Strobes using specular reflectors shall not be considered as equal.

2.4.2.1.1.6 When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

2.4.2.1.1.7 Horn and strobe power, horn silencing, and strobe synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

2.4.2.1.1.8 The low-profile wall mounted speaker-strobes shall be an EDWARDS G4HF series.

2.4.2.1.2 Speaker-Strobe-Ceiling

2.4.2.1.2.1 Provide low profile ceiling mounted speaker-strobes at the locations shown on the drawings.

2.4.2.1.2.2 Speaker-strobes shall mount in a North American 4” x 2 1/8” square electrical box, or a 960A-4RF round flush box, and protrude less than 1.6” from the finished ceiling. The word ALERT shall be prominently displayed on the housing.

2.4.2.1.2.3 The speaker output shall be switch selectable from the following available settings: 2W (91dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (80dBA) at 10 feet (304.8 cm) when measured in reverberation room per UL 1480. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

2.4.2.1.2.4 The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 95cd or 95cd, 115cd, 150cd, &177cd. Selected strobe rating shall be visible when the speaker-strobe is in its installed position. Amber lens strobes shall be available with outputs of 13/26/65/82cd or 82/100/130/155cd.

2.4.2.1.2.5 When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

2.4.2.1.2.6 Strobe power and synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

2.4.2.1.2.7 The low-profile ceiling mounted speaker-strobes shall be an EDWARDS Genesis GCHF series.

2.4.2.1.3 Speaker-Strobe-Outdoor

2.4.2.1.3.1 Provide low profile weatherproof speaker-strobes at the locations shown on the drawings.

2.4.2.1.3.2 Speaker-strobes shall mount in a North American 4” square 1½” deep electrical box for indoor applications without a trim skirt and a and a 4” square 2 1/8”deep electrical box when used with a trim skirt. A factory supplied back box shall be supplied for weatherproof applications.

2.4.2.1.3.3 The speaker-strobe shall be suitable for wall or ceiling mount and operate in temperatures from -40 to 151 degrees Fahrenheit (66.11 degrees Celsius). The word ALERT shall be prominently displayed on the housing.

2.4.2.1.3.4 The speaker output shall be switch selectable from the following available settings:

Wattage	Switch Position	25Vrms	70Vrms
2W	T	90.0 dBA	89.7 dBA
1W	X	87.1 dBA	86.9 dBA
½ W	Y	84.0 dBA	83.9 dBA
¼ W	Z	80.8 dBA	80.8 dBA

2.4.2.1.3.5 Output is at 10 feet (304.8 cm) when measured in reverberation room per UL 464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

2.4.2.1.3.6 The strobe output shall be switch selectable as required by its application from the following available settings:

		Standard Candela Output Speaker-Strobes				High Candela Output Speaker-Strobes			
		Strobe Switch Position							
Listing	Location	D	C	B	A	D	C	B	A
UL 1971	Indoor, Clear lens	15 cd	29 cd	70 cd	87 cd	102 cd	123 cd	147 cd	161 cd
UL 1971	Indoor, Amber lens	13 cd	25 cd	59 cd	62 cd	84 cd	101 cd	125 cd	130 cd
UL 1638	Outdoor, lear lens	6 cd	12 cd	28 cd	35 cd	41 cd	50 cd	60 cd	65 cd
UL 1638	Outdoor, mber lens	5 cd	10 cd	24 cd	25 cd	34 cd	41 cd	51 cd	52 cd

2.4.2.1.3.7 Selected strobe rating shall be visible when the speaker-strobe is in its installed position.

2.4.2.1.3.8 When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

2.4.2.1.3.9 Horn and strobe power, horn silencing, and strobe synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

2.4.2.1.3.10 The weatherproof speaker-strobes shall be EDWARDS Genesis WG4 Series.

3. EXECUTION

3.1 INSTALLATION

3.1.1 General

3.1.1.1 General

3.1.1.1.1 The entire system shall be installed in a skillful manner in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams.

3.1.1.1.2 All work shall be performed in accordance with the requirements of NFPA 70 and NFPA 72.

3.1.1.1.3 Coordinate locations of all devices with all other divisions' drawings and specifications.

3.1.1.1.4 All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the contract drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer.

3.1.1.1.5 Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.

3.1.1.1.6 All systems and system components listed to UL 864 Control Units for Fire Protective Signaling Systems may be installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s) or system components not listed to the UL 864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

3.1.1.1.7 No wiring except life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures.

3.1.1.1.8 Any low-voltage copper wiring that leaves the protection of a building shall be provided with a compatible UL 497B listed transient protection devices where the circuit leaves the building and where it enters the next building.

3.1.1.1.9 All Devices shall be labeled with its address in 24 font. Devices containing end-of-line resistors shall be appropriately labeled, 24 font. Devices should be labeled such that removal of the device is not required to identify the EOL device.

3.1.1.1.10 Concrete floors shall be X-rayed prior to core drilling on post tension slabs. Verify with engineer on type of slab prior to bid.

3.1.2 Electrical

3.1.2.1 Electrical

3.1.2.1.1 Boxes, enclosures and wiring devices

3.1.2.1.1.1 Boxes shall be installed plumb and firmly in position.

3.1.2.1.1.2 Extension rings with blank covers shall be installed on junction boxes where required.

3.1.2.1.1.3. Junction boxes served by concealed conduit shall be flush mounted.

3.1.2.1.1.4 Fire alarm system junction boxes and covers shall be factory finished red.

3.1.2.1.1.5 All fire alarm wiring to be in factory red finish conduit no smaller than ¾". Free-run fire alarm wiring not allowed.

3.1.2.1.1.6 Wiring within cabinets, enclosures, boxes, junction boxes and fittings shall be installed in a neat and workmanlike manner, installed parallel with or at right angles to the sides and back of any box, enclosure or cabinet, and routed to allow access for maintenance. All conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with approved pressure type terminal blocks, which are securely mounted. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type. No more than two conductors shall be installed under

one connection. Wire nuts, crimp splices and similar devices shall not be used.

3.1.2.1.2 Conductors

3.1.2.2.1.1 Each conductor shall be identified as shown on the drawings at terminal points. Permanent wire markers shall be located within 2 inches (50.8 mm) of the wire termination. Marker text shall be visible with protective doors or covers removed.

3.1.2.2.1.2 Maintain a consistent color code for fire alarm system conductor functions throughout the installation.

3.1.2.2.1.3 All wiring shall be installed in compliance with the National Electric Code, NFPA 70, and the equipment manufacturer’s requirements.

3.1.2.2.1.4 Wiring for Signaling Line Circuit and Initiating Device Circuit field wiring shall be solid copper, No. 18 AWG twisted pair conductors at a minimum. Speaker circuits; 16 AWG twisted pair at a minimum. Telephone circuits shall be 18 AWG twisted- shielded pair at a minimum. 24VDC visual and audible Notification Appliance Circuits shall be solid copper No. 14 AWG size conductors at a minimum. The wiring sizes listed herein are minimum sizes. Use larger wire sizes when recommended by the manufacturer, based on system configuration and project specific calculations.

3.1.2.2.1.5 Where shielded wiring is used, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP or other control equipment. Shields shall be continuous, treated as a third conductor, and insulated from ground except as noted.

3.1.2.2.1.6 T-taps (branches) are discouraged in Class B SLC circuits with interconnections occurring on terminal strips.

3.1.2.2.1.7 Circuits to third-party systems (HVAC, Elevators, fire pumps, etc.) shall terminate in terminal cabinets within three (3) feet of the controllers for those systems.

3.1.2.2.1.8 AC power wiring shall be No. 12 AWG solid copper having insulation rated for 600 volts.

3.1.2.2.1.9 Crimp type spade lugs shall be used for terminations of stranded conductors to binder screws or stud type terminals.

3.1.2.2.1.10 All wiring shall be checked and tested to ensure that there are no grounds, opens or shorts.

3.1.2.1.3 Devices

3.1.2.1.3.1 All devices and appliances shall be mounted to or in an approved electrical box.

3.1.2.1.4 Raceways

3.1.2.1.4.1 Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.

3.1.2.1.4.2 Install all conductors in finished wire mold, rigid metal conduit or factory finished electro-metallic tubing, utilizing compression type fittings and couplings, with a minimum diameter 3/4". The use of flexible metal conduit not exceeding a six (6) foot length shall be permitted for initiating device circuits.

3.1.2.1.4.3 All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or fire damage, and shall not interfere with existing building systems, facilities or equipment.

3.1.2.1.4.4 Run conduit or tubing concealed in finished areas unless specifically shown otherwise on the drawings. Conduit may be exposed in unfinished mechanical/electrical rooms, and basement levels. Run exposed wire mold in finished areas.

3.1.2.1.4.5 All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back box locations shall be readily accessible for inspection, testing, service and maintenance.

3.1.3 FA Components

3.1.3.1 Devices

3.1.3.1.1 All devices and appliances shall be mounted to or in an approved electrical box.

3.1.3.1.2 All wall mounted control equipment shall comply with requirements defined by the International Building Code.

3.1.3.2 Fire Alarm Control Panels

3.1.3.2.1 Mount the enclosure with the top of the cabinet 72” above the finished floor or center the cabinet at 63”, whichever is lower.

3.1.3.2.2 Label the fire alarm panels with the room number, electrical panel number and circuit breaker number feeding them.

3.1.3.2.3 Paint the handles of the dedicated circuit breakers feeding fire alarm panels red, and install handle locks.

3.1.3.2.4 Within the panel, all non-power limited wiring must be properly separated from power limited circuits.

3.1.3.2.5 Grounds shall comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.1.3.3 Remote Annunciator

3.1.3.3.1 Mount the panel; with the top of the panel 72” above the finished floor or center the panel at 63”, whichever is lower.

3.1.3.3.2 Remote power supplies and auxiliary fire alarm panels

3.1.3.3.3 Locate the panel or cabinet with the top of the panel 72” above the finished floor or center the panel at 63”, whichever is lower.

3.1.3.3.4 Do not locate these panels above ceilings or where inaccessible by a person standing on the finished floor of the space.

3.1.3.3.5 Label the power supplies and auxiliary FACPs with the room number, electrical panel number and circuit breaker number feeding them.

3.1.3.3.6 Paint the handles of the dedicated circuit breakers feeding fire alarm panels red, and install handle locks.

3.1.3.3.7 Within the panel, all non-power limited wiring must be properly separated from power limited circuits.

3.1.3.4 Manual Pull Stations

3.1.3.4.1 Mount stations so that their operating handles are between 42” and 48” above the finished floor.

3.1.3.5 Notification Appliances: Mount assemblies as follows:

3.1.3.5.1 All wall mounted audio/visual devices shall be mounted so the entire lens is between 80” and 96” above the finished floor. Where low ceilings exist, devices shall be mounted within 6” of the ceiling.

3.1.3.5.2 Each speaker’s output shall be set to the wattage value indicated for its specific location as shown on the drawings.

3.1.3.5.3 Each strobe’s output shall be set to the candela value indicated for its specific location as shown on the drawings.

3.1.3.5.4 Each speaker-strobe’s outputs shall be set to the wattage/candela value indicated for its specific location as shown on the drawings.

3.1.3.5.5 Where ceiling height exceeds 30 feet (914.4 cm), appliances shall be suspended from the ceiling to a height of 30 feet maximum above the finished floor.

3.1.3.5.6 Appliances installed outdoors shall be UL listed for outdoor use.

3.1.3.6 Smoke Detectors:

3.1.3.6.1 Smoke and heat detector heads shall not be installed until after construction clean-up is completed. Detector heads installed prior to construction clean-up shall be cleaned by the manufacturer or replaced.

3.1.3.6.2 Detectors located on the wall shall have the top of the detector at least 4" and not more than 12” below the ceiling.

3.1.3.6.3 On smooth ceilings, detectors shall not be installed over 30 feet (914.4 cm) apart in any direction.

3.1.3.6.4 Install smoke detectors no closer than 3 feet (91.44 cm) from air handling supply air diffusers or return air openings.

3.1.3.6.5 Locate detectors no closer than 12” from any part of a lighting fixture.

3.1.3.7 Duct Smoke Detectors:

3.1.3.7.1 Install sampling tubes so they extend the full width of ducts exceeding 36”.

3.1.3.7.2 Detectors shall be located to facilitate ease of maintenance.

3.1.3.7.3 All penetrations near detectors located on/in return ducts shall be sealed to prevent air entry.

3.1.3.8 End-of-Line Resistors

3.1.3.8.1 Devices containing end-of-line resistors shall be appropriately labeled.

3.1.3.9 Remote Status and Alarm Indicators:

3.1.3.9.1 Install near each smoke detector and each sprinkler water-flow switch and valve- tamper switch that is not readily visible from normal viewing position.

3.1.3.10 Heat Detectors

3.1.3.10.1 Heat detectors shall be installed in strict accordance with their UL listing and the requirements of NFPA 72.

3.1.3.10.2 Heat detectors installed in the elevator machinery room to meet ANSI A17.1 requirements for elevator power disconnect, shall be located adjacent to each sprinkler head. Coordinate temperature rating and location with sprinkler rating and location.

3.1.3.11 Addressable Control (relay) Modules

a. Install the module less than 3 feet (91.44 cm) from the device controlled.
b. 3.1.3.11.2. Orient the device mounting for best maintenance access.
c. Label all addressable control modules as to their function.
d. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads (auxiliary relays, door holders). Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.

END OF SECTION

FIRE ALARM PERFORMANCE SPECIFICATIONS

4-LCD- MOUNT THE 4-LCD IN SLOT 1 AND 2 OF THE OPERATOR LAYER.

4-24L24S BUTTON STRIP- MOUNT THE 4-24L24S BUTTON STRIP IN SLOT 3 OF THE OPERATOR LAYER.

4-MIC- MOUNT THE 4-MIC IN SLOT 11 AND 12 OF THE OPERATOR LAYER.

FACU NODE-NODE PSEUDO POINTS. ROUTE PSEUDO 622 $OUTGOING CALL IN PROGRESS TO NONE ON BOTH MESSAGE ROUTE AND ALTERNATE MESSAGE ROUTE.

PROJECT DATA-DEFAULT IMAGE. ADD MSU LOGOJPG.

TIMERS- USER TIMEOUT 8 HOURS-SERVICE GROUP TIMEOUT 8 HOURS.

LCD CONTROLS AND INDICATORS- CHANGE LCD BUTTON 2 TO LAMP TEST.

LOGICS- ADD TIME CONTROL FOR DAYLIGHT SAVINGS.

LCD CONfiGURATION-QUEUES PRIORITY-ALARM AND EMERGENCY ONLY.

SLC- LOCATION TEXT- WHEN CREATING LOCATION TEXT, ENSURE THE fIOOR FL AND RM # IS AT THE BEGINNING OF THE LABEL AND ENSURE THE DEVICE TYPE IS CALLED OUT. SOME EXAMPLES:

1FL RM 142EL SMOKE DETECTOR

1FL RM 209 RTU-1 DUCT DETECTOR

1FL ELEVATOR 1 LOBBY SMOKE DETECTOR

2FL RM 219EL BOOSTER PANEL (“”) POWER SUPEREVISON

SEE MSU FIRE TECH FOREMAN FOR ANY CLARIfiCATION NEEDED PRIOR TO PRETEST.

SMOKE AND HEAT DETECTORS- ON ALL SMOKE AND HEAT DETECTORS, REMOVE THE BAR CODE STICKERS THAT ARE ATTACHED TO THE DETECTOR. THE ONLY STICKERS SHALL BE THE DEVICE ADDRESS ON THE DETECTOR TRIM SKIRT. EX. 001:002:0015 (24 FONT).

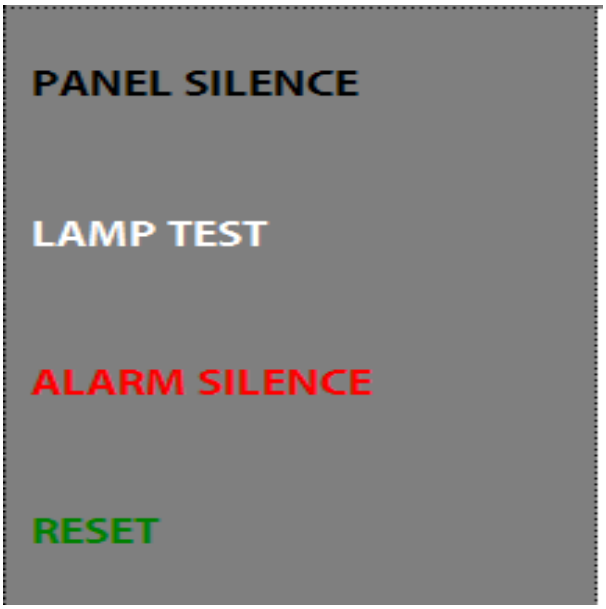
LCD- LABEL INSERT TEXT

INDICATOR LABEL NODE SILENCE INSERT TEXT PANEL SILENCE FONT FAMILY ADOBE GOTHIC STD B FONT COLOR BLACK BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10.

INDICATOR LABEL LAMP TEST INSERT TEXT LAMP TEST FONT FAMILY ADOBE GOTHIC STD B FONT COLOR WHITE BACKGROUND COLOR [GRAY #FF7F7F7F] FONT SIZE [10].

INDICATOR LABEL ALARM SILENCE INSERT TEXT ALARM SILENCE FONT FAMILY ADOBE GOTHIC STD B FONT COLOR RED BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10.

INDICATOR LABEL RESET INSERT TEXT RESET FONT FAMILY ADOBE GOTHIC STD B FONT COLOR [GREEN] BACKGROUND COLOR [GRAY #FF7F7F7F] FONT SIZE [10].



4-24L24S BUTTON STRIP PROGRAMMING

SW1- STEADY INDICATOR COLOR WHITE INSERT TEXT ALL CALL FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR WHITE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW1 SHALL NOT BE PASSWORD PROTECTED.

SW2-SW11-THESE ARE USED FOR ZONE PAGING. STEADY INDICATOR COLOR WHITE INSERT TEXT TO BE DETERMINED FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR WHITE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW2-SW11 SHALL NOT BE PASSWORD PROTECTED.

SW12- NOT USED. LEAVE BLANK. BACKGROUND COLOR GRAY #FF7F7F7F.

SW13- SLOW BLINK INDICATOR COLOR YELLOW INSERT TEXT A/V DISABLE THIS WILL DISABLE ALL THE SPEAKER/STROBES INCLUDING THE FDC HORN/STROBE. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR YELLOW BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW13 SHALL BE PASSWORD PROTECTED.

SW14- SLOW BLINK INDICATOR COLOR BLUE INSERT TEXT AUX DISABLE THIS WILL DISABLE DOOR MAGS, RTU/HVAC SHUTDOWNS DAMPER SHUTDOWNS. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR BLUE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW14 SHALL BE PASSWORD PROTECTED.

SW15- NOT USED. LEAVE BLANK. BACKGROUND COLOR GRAY #FF7F7F7F.

SW16- SLOW BLINK INDICATOR COLOR YELLOW INSERT TEXT MAIN WALKTEST THIS WILL INCLUDE ALL SMOKES, HEATS, DUCTS, AND PULLS. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR YELLOW BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW16 SHALL BE PASSWORD PROTECTED.

SW17- SLOW BLINK INDICATOR COLOR BLUE INSERT TEXT SPRINKLER WALKTEST THIS WILL INCLUDE ALL WATERflOWS AND TAMPER VALVES. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR BLUE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW17 SHALL BE PASSWORD PROTECTED.

SW18- SLOW BLINK INDICATOR COLOR WHITE INSERT TEXT GAS ACCEL MODE FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR WHITE BACKGROUND COLOR GRAY #FF7F7F7F. SW18 SHALL NOT BE PASSWORD PROTECTED.

SW19-SW21- NOT USED. LEAVE BLANK. BACKGROUND COLOR GRAY #FF7F7F7F.

SW22- FAST BLINK INDICATOR COLOR RED INSERT TEXT FIRE DRILL WHEN WRITING THIS RULE, ACTIVATE THE ALARM AND ALL SHUTDOWNS ASSOCIATED WITH A GENERAL ALARM. EXCEPT FOR MONITORING. THIS BUTTON SHALL NOT SEND A CMS SIGNAL. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR RED BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW22 SHALL NOT BE PASSWORD PROTECTED.

SW23- FAST BLINK INDICATOR COLOR BLUE INSERT TEXT CO DRILL WHEN WRITING THIS RULE, ACTIVATE THE 4 TEMPORAL FOR CO. THIS BUTTON SHALL NOT SEND A CMS SIGNAL. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR BLUE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW23 SHALL NOT BE PASSWORD PROTECTED.

SW24- NOT USED. LEAVE BLANK. BACKGROUND COLOR GRAY #FF7F7F7F.



ANNUNCIATORS

ROUTE THE SERVICE GROUP MESSAGES TO MAIN FACU ONLY. (THE ANNUNCIATORS SHALL DISPLAY THE MSU LOGOJPG DURING A SERVICE GROUP ACTIVATION). SEE MSU FIRE TECH FOREMAN FOR DETAILS.

LCD CONfiGURATION-QUEUES PRIORITY-ALARM AND EMERGENCY ONLY.

LCD- LABEL INSERT TEXT- MATCH MAIN FACU NODE.

4-LCD- MOUNT THE 4-LCD IN SLOT 1 AND 2 OF OPERATOR LAYER.

4-24L24S- MOUNT IN SLOT 3 OF THE OPERATOR LAYER.

4-MIC- MOUNT THE 4-MIC IN SLOT 4 AND 5 OF THE OPERATOR LAYER.

4-24L24S ANNUNCIATOR BUTTON STRIP PROGRAMMING

SW1- STEADY INDICATOR COLOR WHITE INSERT TEXT ALL CALL FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR WHITE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW1 SHALL NOT BE PASSWORD PROTECTED.

SW2-SW11- THESE ARE USED FOR ZONE PAGING. STEADY INDICATOR COLOR WHITE INSERT TEXT TO BE DETERMINED FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR WHITE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW2-SW11 SHALL NOT BE PASSWORD PROTECTED.

SW12- NOT USED. LEAVE BLANK. BACKGROUND COLOR GRAY #FF7F7F7F.

SW13-SW21- NOT USED. LEAVE BLANK WITH BACKGROUND COLOR GRAY #FF7F7F7F.

SW22- FAST BLINK INDICATOR COLOR RED INSERT TEXT FIRE DRILL WHEN WRITING THIS RULE, ACTIVATE THE ALARM AND ALL SHUTDOWNS ASSOCIATED WITH A GENERAL ALARM. EXCEPT FOR MONITORING. THIS BUTTON SHALL NOT SEND A CMS SIGNAL. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR RED BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW22 SHALL NOT BE PASSWORD PROTECTED.

SW23- FAST BLINK INDICATOR COLOR BLUE INSERT TEXT CO DRILL WHEN WRITING THIS RULE, ACTIVATE THE 4 TEMPORAL FOR CO. THIS BUTTON SHALL NOT SEND A CMS SIGNAL. FONT FAMILY GILL SANS ULTRA BOLD CONDENSED FONT COLOR BLUE BACKGROUND COLOR GRAY #FF7F7F7F FONT SIZE 10. SW23 SHALL NOT BE PASSWORD PROTECTED.

SW24- NOT USED. LEAVE BLANK. BACKGROUND COLOR GRAY #FF7F7F7F.



CMS MONITORING

3-MODCOM- MSU WILL PROVIDE THE CONTRACTOR WITH A 4-DIGIT ACCOUNT # ONCE ACCOUNT IS SET UP.

PHONE NUMBER 1- 0123456789, PHONE NUMBER 2- 9876543210

TIMERS- TEST MODE TIME OF DAY, TEST TIME INTERVAL 1, TEST MESSAGE TIME OF DAY 0:8:30.

POINT 1- GENERAL ALARM (SMOKE DETECTORS, HEAT DETECTORS, PULL STATIONS)

POINT 2- WATERFLOW ALARM

POINT 3- SUPERVISORY

POINT 4- TROUBLE

POINT 5- CO ALARM

END OF SECTION 28 4600

FIRE ALARM SYSTEM
PRODUCT DATA SUBMITTAL

MONTANA STATE UNIVERSITY
MOLECULAR BIOSCIENCE BUILDING

960 TECHNOLOGY BLVD.
BOZEMAN, MT 59715

Prepared By:

APEX FIRE ALARM DESIGN, LLC

1/15/2026

FIRE ALARM SYSTEM
PRODUCT DATA SUBMITTAL

MANUFACTURER	PART NO	DESCRIPTION
EDWARDS	EST4 FACU	FIRE ALARM CONTROL UNIT
EDWARDS	4-6ANN	REMOTE LCD ANNUNCIATOR
EDWARDS	ECG1-P	CELLULAR COMUNICATOR
EDWARDS	BPS10A	REMOTE BOOSTER POWER SUPPLY
EDWARDS	MFC-A / UIO6	MULTIFUNCTION CABINET
EDWARDS	SIGA-278	DOUBLE ACTION MANUAL STATION
EDWARDS	SIGA-CC1S	SYNCRONIZING SIGNAL CONTROL MODULE
EDWARDS	SIGA-CT1	ADDRESSABLE SINGLE INPUT MODULE
EDWARDS	SIGA-CT2 / MCT2	ADDRESSABLE DUAL INPUT MODULE
EDWARDS	SIGA-MCR	ADDRESSABLE CONTROL RELAY
EDWARDS	SIGA-CRH	ADDRESSABLE CONTROL RELAY (HIGH)
EDWARDS	SIGA-HRD	INTELLIGENT HEAT DETECTOR
EDWARDS	SIGA-OSD	INTELLIGENT SMOKE DETECTOR
EDWARDS	SIGA-SB4	STANDARD BASE
EDWARDS	G4SVWA	SPEAKER/STROBE - WALL
EDWARDS	GCSVWA	SPEAKER/STROBE – CEILING
EDWARDS	GCSWA	SPEAKER - CEILING
EDWARDS	GCVWN	STROBE - CEILING
DITEK	DTK-120HW	120VAC SURGE PROTECTION DEVICE
SPACE AGE	SSU00689	DOCUMENT BOX

LIFE SAFETY & INCIDENT MANAGEMENT

EST4

Emergency Communications Platform



FM APPROVED | NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL | UL | ULC | CE EN54

Overview

EST4 is the premier emergency communications system from EDWARDS. Though it represents a small change in name from its predecessor, EST4's leap forward in capability is anything but diminutive. This exciting flagship system features a whole new network architecture that makes fire alarm, mass notification, and building integration easy to implement, quick to service, and secure in the face of today's cyberthreats.

From its thoughtfully-crafted interface to its advanced connectivity and extensive system capacity, EST4 demonstrates that form and function are inseparable elements of good system design. It provides systems engineers with the tools they need to create projects that exceed expectations and have plenty of room to grow, all while respecting facility budgets and construction schedules. The net result is an emergency communications system equally suited to new and retrofit projects; a platform that keeps property safe and steers people clear of danger.

Features

- **Investment-forward Platform Designed for the Future**
  Protects the past with backwards compatibility for EST3 retrofits, flexible feature set.
- **On-board Webserver**
  Remote device-independent access to system status reports.
- **Built-in E-mail and E-mail-to-SMS Messaging**
  Instant notification of specific event types sent to appropriate personnel.
- **Large Full-color LCD Touch Screen with Tactile Buttons**
  Fast, intuitive access to service and first responder functions.
- **Five-color LED Indicators**
  System status at a glance, select the color needed during programming, reduces replacement part inventory, maximizes use of available infrastructure.
- **Network data, audio data, and telephone data share a single twisted pair or single fiber strand**
  Up to 75 percent less cabling, substantial cost savings in material and labor.
- **Backwards Compatibility with EST3**
  Wiring, devices, and most local rail modules are backward compatible, providing easy migration paths, economical transition to new technology.
- **Existing Systems Supporting only Network Data can also Support Voice Audio**
  Upgrades add value and extend capabilities in retrofit situations.

continued on next page...

Application

From the moment the control panel is powered up it is apparent that EST4 is designed for ease of use. Its powerful user interface bears this out by allowing operators to use the system with a level of fluidity that naturally guides them through high and low level system operations with efficiency and confidence.

EST4 does this by combining the simplicity of color LCD touchscreen technology with at-a-glance programmable color display strips and tactile direct-access control buttons. These input points, together with meticulously-engineered first responder and service functionality, allow EST4's interface to provide clear navigation paths, instant-access shortcuts, and context-sensitive display screens. This means that first responders have quick access to vital system event information and control functions, while service personnel can dive deeply into system programming unencumbered by complicated operational routines.

EST4's LCD large touch-screen display is the window into system operation and maintenance functions. It is large enough to support a graphical tree view of the system. The tree closely matches the system's physical layout, so there's no need for look-up tables to find specific devices. This is invaluable to technicians and building service personnel who can pinpoint the location of an off-normal device with a glance at the on-screen tree.

The EST4 LCD is capable of displaying 262,144 colors, EST4's LCD display screen will display eight events without scrolling. In addition to touch-screen capability, the display assembly includes four dedicated easy-access rubber buttons for control functions most needed for emergency response.

Up to 576 tactile switches and 576 LED indicators may be mounted in a single EST4 cabinet for control and annunciation purposes. Control Display Modules (CDMs), comprise a column of programmable buttons accompanied by one or two LED indicator positions per button. Indicator-only modules comprise up to 24 indicators. Switch and indicator module LEDs can be set to any of five colors, providing an additional level of feedback.

Print-anywhere slide-in label inserts give control/display strips context with color-coded shading and other effects. They can be localized for regional language requirements, and printed on-the-fly to accommodate system changes as they are implemented.

Features (continued from page 1)

- **Self-configuring Network**
  No intervention by system admin personnel required.
- **Hot Swappable Network Connections**
  Change from copper to fiber with no system down-time.
- **480 Mbps USB Ports on Panels**
  Fast configuration updates, local printing.
- **Advanced Upload/download Protocol**
  No system down-time during updates.
- **Firewalls meet the latest Advanced Encryption Standards**
  Front-line defense against threats carried by outside networks. NIST - AES Validation #4806.
- **Extended Paging Groups**
  Audio reaches occupants based on location and movement.
- **Local and Remote Reporting**
  Generate reports on-site, at system printers, or remotely via webserver.
- **20,000-event History**
  Invaluable timeline data for service and investigative purposes.
- **Cabinet Doors may be used for Nodes and Annunciators**
  Cabinet Doors may be used for Panels and Annunciators giving a consistent appearance, fewer cabinet parts.

Remote access and notification

System access to EST4 doesn't end when the cabinet door swings shut. A webserver in each EST4 panel allows authenticated users to gain access to day-to-day reporting. EST4 webservices are device-independent and support all major browsers on PC and MAC operating systems, including mobile platforms – without the need for special apps or other software. Users can log into the secure EST4 webserver and run system reports. Like any web page, system reports can be copied, printed, saved, and e-mailed. The system report data can also be saved in XML form and used in external spreadsheet applications for further processing.

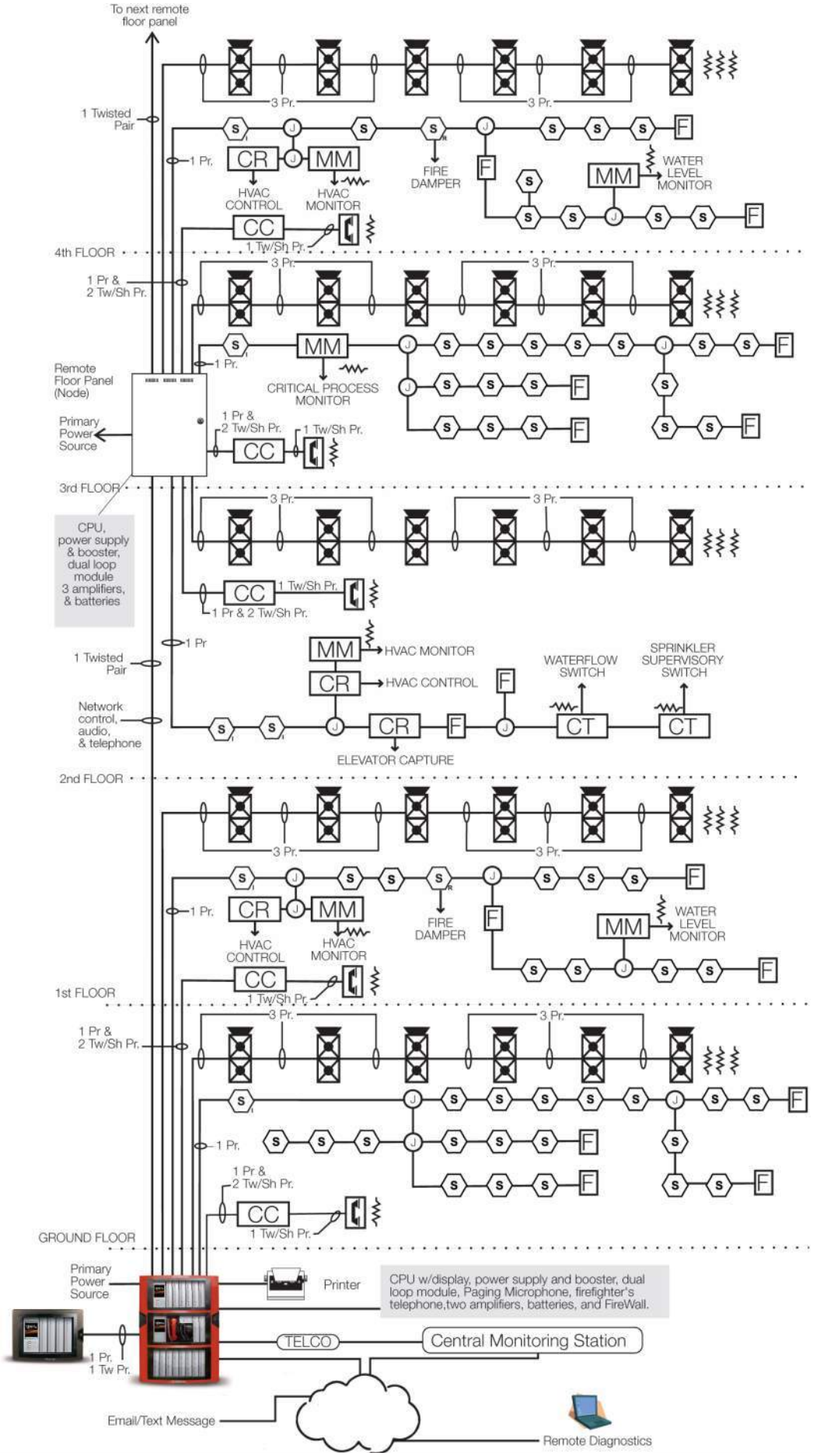
EST4 keeps up with the fast pace of mobile computing with its built-in e-mail services and e-mail-to-text-message capabilities. These ensure that key personnel receive instant notification of relevant changes of system state. Technicians can be dispatched to the site within minutes of a service event, while safety and security personnel can arrive concurrently with first responders should the system go into alarm.

Networking

Supporting these important interface developments is a robust system underpinned by solid networking and exceptional security. Thanks to its self-configuring network, EST4 easily deploys and configures without intervention by network administration personnel. It adapts to a wide range of network configurations, including rings, stars, redundant segment, and full mesh topology. The network even allows changes in the physical layer from copper to fiber, and employs hot-swappable network connections at control panels and annunciators. All this improves network reliability and saves money at installation time and throughout the equipment's life cycle.

The advanced technology behind EST4's network is powerful enough to drive the biggest installations viable today. It pushes wire runs into miles, and addressable points into the many of thousands. A single IPv6 or mesh network, for example, can support copper wire runs of nearly a mile between nodes puts detection, alarm, notification, and audio into the furthest reaches of the tallest buildings and broadest campuses. Fiber optic cable handles multiple miles between nodes, while carrying all system data on a single fiber strand.

Riser Diagram



System design benefits greatly from this huge capacity. Minimal cabling requirements take scalability a step further. With EST4 a single copper pair or single fiber supports panel network data, audio data, as well as telephone data. This cuts cable counts by up to 75 percent. Meanwhile, multiple firefighter's telephones risers are accommodated on the network, which allows them to be deployed at much further distances compared with analog audio transmission methods.

Reduced network cabling not only boosts system efficiency by requiring fewer physical connections, it also saves money by reducing material and labor costs. This means that new EST4 installations benefit from lower cable counts, while retrofits may be able to be upgraded to support audio and telephones without the need to pull additional cable.

For new installations EST4 delivers flexibility. It can use twisted pair wire, Multi-mode fiber, Single Mode fiber, and even CAT5 cable. In fact CAT5 is not restricted to Class N applications. It also meets the stringent requirements of Class A, Class B, and Class X. When using CAT5, distances are not limited to 328 ft. (100 m). EST4's CAT5 support includes a solution that allow up to 3,280 ft. (1 km) of cable length.

Cybersecurity

The security and integrity of the EST4 network is paramount to its ability to maintain systems operations in the face of outside threats. The most vulnerable point of contact for any integrated building system is where it meets the facility owner's existing TCP/IP network. Ironically it is this gateway, which enhances and expands system capability beyond the communications network, that also exposes the system to some of its most critical vulnerabilities.

To combat outside threats, every EST4 panel can deploy proxy firewalls that effectively insulate the internal fire network from external Intranet or internet connections and the malware, ransom ware, and denial-of-services attacks that may be raging beyond. The EST4 proxy firewall uses Advanced Encryption Standard (AES) encryption and secure protocols making it FIPS Pub 197 certified. The FIPS, Federal Information Processing Standards, are the most current and most advanced encryption protocols administered by the National Institute of Standards and Technology (NIST).

EDWARDS recommends the installation of robust commercial firewall between the facilities intra-net and the Internet. To further enhance network security, an optional tamper switch may be installed on EST4 cabinet doors. This alerts the system when equipment enclosures are accessed.

Programming

EST4 is an open book for authorized programmers. Configuration data travels in both directions: it can be downloaded to the panel and uploaded to a laptop. This two-way movement of configuration files allows technicians to upload and backup programming before making changes to the system. By doing so, the tech ensures that trustworthy restore points are available at all times. Also, should the building owner change service companies, up-to-date system programming data can be retrieved with proper authorization, from the panel by the new maintenance personnel in minutes.

Adding to the integrity of panel configuration is an advanced data transfer routine that does not compromise or interrupt normal system operation. This keeps the system fully functional during configuration data exchange – logging events and executing programming during the entire process.

EST4's high-performance Configuration Utility (CU) depicts the system in a graphical tree view, which matches the system's physical layout. This provides a familiar format in which to find programming for specific devices, and also does away with the need for look-up lists when, for example, devices need to be taken out of service because of site specific activities. The programming tool also features a context-sensitive Intellisense rule editor, which checks for syntax and semantic programming errors in real time.

The EST4 Configuration Utility (CU) also makes short work of configuration downloads to the control panel. It does this through a single firmware download for all modules, and a single database download for all node databases.

EST4's on-board USB ports also make it easy to connect with external devices. The USB ports do away with special cables and RS232-to-USB conversion dongles. It allows direct high-speed connection with laptops for the exchange of configuration data at transfer rates of up to 480 Mbps. Printers can be connected to panels or remote annunciators for on-site event and report printouts.

Audio

Nothing informs building occupants better than the spoken word, and EST4's highly intelligible voice audio ensures that those words are heard loud and clear. This high fidelity messaging, across EST4's impressive capacity of 200 channels, provides the flexibility that responders need to get messages out clearly and concisely.

EST4 live paging capabilities ensure that those messages reach the right people at the right time. In addition to standard paging functions (Page to Evacuation, Page to Alert, All Call, and All Call Minus), EST4 introduces Page to Other and Page to Emergency.

Page to Other is a quick way to reach people in stairwells and elevators, while Page to Emergency is for Mass Notification purposes. This added live paging capability allows responders to reach occupants based not only on their proximity to danger, but also based on their potential to move inadvertently towards specific danger points.

EST4 live paging also lets responders select individual paging groups as well as combinations of groups. This allows them to reach people in Alert and Evacuation zones simultaneously without having to page one group, and then page the other.

Reporting System Snapshots

EST4 can generate an abundance of stock reports, and users may also design their own within the configuration utility. Printed reports can be generated locally at any control panel, node, or annunciator. Familiar USB connections allow for quick uploading to laptops or transfer to locally-connected printers. Reports can also be sent from any of these locations to system printers elsewhere on the network.

EST4 allows the selection of report data right down to the device level by means of pre-built templates, custom reports, or even on-the-fly using the CU configuration tool. Report content is information rich, detailed, and meaningful. This meticulous report formatting and organization results in highly understandable system overviews and useful deep dives into underlying system configuration data.

Event History Timelines

While system status reports are invaluable for generating snapshots of important data, EST4's event history can paint a vivid picture of the system over time. A giant 20,000-event repository comprises EST4's history, which could span back as far as the system's commissioning. Half of the history can be set aside exclusively for Alarms, ensuring that records of the most important events are preserved. To support forensic investigations, up to 10,000 events can be locked and preserved so as not to be overwritten.

A large variety of pre-built history reports are available for quick access to vital records filtered by day, week, month or year. Custom reports help pinpoint records by date, time, location, device type and more. Together EST4's large history capacity and flexible history reporting serve to create vital timelines that aid in system maintenance and forensic investigations.

Value-added Forward Migration

Easy migration paths ensure an economical transition from EST3 platforms to EST4's next-generation technology. To start, configuration data is easily transferable from an existing EST3 project to an EST4 upgrade. Hardware is also easy to migrate: all Signature Series devices, modules, and service tools are fully supported by EST4, as are Genesis series notification appliances – no rewiring is required.

Existing network cabling is also reusable for upgrades. EST4 even supports network messaging plus live paging with legacy wiring. In fact, simple twisted pair wiring, previously useable only for panel-to-panel data communications can, with EST4, support panel data, paging, as well as telephone. This means that voice audio capability may be added to a system originally wired only for network panel to panel communications – without pulling any additional wire.

EST4 also employs EST3 power supplies, audio amplifiers, MNEC equipment, CAB Series wallboxes, and most local rail modules. This makes the move to EST4 a cost-effective choice for existing installations, and new projects alike. It is a move that will benefit system efficiency and scalability now and for many years into the future.

Agency Approvals

UL864 10th edition - UOJZ, UUKL, SYZV, UOQY

UL2017 2nd edition - FSZI

UL2572 2nd edition - PGWM

ULC-S527-11 3rd edition - UOJZ, UULK7, SYXV7

ULC-S576-14 1st edition - PGWM7

ULCS-S559-13 2nd edition - DYR7

FM

CE

EN54

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

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LIFE SAFETY & INCIDENT MANAGEMENT

EST4 Central Processing Unit

4-CPU



FM APPROVED | NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL | UL | ULC | CE | EN54

Overview

EST4's Central Processing Unit, the 4-CPU, is a control panel card that manages data generated by local modules and acts as a nexus for system-wide network communication. It accomplishes this by pulling data from local rail modules in real time and facilitating both intra-module data exchange, and inter-node communications with remarkable speed and efficiency.

The 4-CPU is, in essence, the gatekeeper for events reported to modules from field devices; it is the controller of audio data; the caretaker of event logs; the guardian of security; and, the link to central monitoring facilities. The EST4 Emergency Communications Platform is built upon system nodes, and the 4-CPU is controller of the nodes.

The hardware that supports 4-CPU operation is robust enough to handle the complex and critical tasks it is assigned. The 4-CPU's eight gigabytes of on-board memory storage holds nearly two hours of pre-recorded audio messaging, as well as an expansive project database. It also holds a large on-board history – large enough to handle more than 10,000 alarm events – and room to store up to 10,000 locked or frozen events held for investigative purposes.

Thanks to its self-configuring network, EST4 nodes easily deploy and configure without intervention by network administration personnel. They adapt to a wide range of network configurations, including rings, stars, redundant segment, and full mesh topology. The 4-CPU even allows changes in the physical layer from copper to fiber, and employs hot-swappable network connections. All this improves network reliability and saves money at installation time and throughout the equipment's life cycle.

Standard Features

- **20,000 event history**
  Large history ensures system events are captured plus additional 10,000 event EST4 *History Freeze* function.
- **SFP style Network Communications Media Options**
  Supported media types include, twisted pair, CAT5, Single and Multimode Fiber in any combination.
- **Up to 750 Minutes of Stored Voice Messages**
  Memory is standard on-board. No need for additional modules.
- **USB V2.0 Type A Host Port**
  High speed connection for printers and hubs.
- **USB V2.0 Type B Device Port**
  High speed connection supports laptops.
- **Integrated Audio Synchronization**
  The 4-CPU synchronizes audio signals across the network, ensuring clear messaging over long distances.
- **Optional Form C Alarm, Supervisory, Trouble Contacts**
  Space for the 4-COMREL Common Relay Module. Relays are rated 30Vdc at 1A. Supports wire sizes from 18 to 12AWG.
- **Optional USB Hub**
  Expands the USB capability of the CPU to meet application needs, comes with RS-232 port.
- **Optional Audio Support**
  Space provided for the 4-AUDTELS Audio I/O and Telephone Riser source module.
- **Simple Plug-in Design**
  Easy installation, no special tools required, CPU simply plugs onto the panel rail.

DATA SHEET E85014-0010
Not to be used for installation purposes. Issue 3.0

Application

The 4-CPU makes EST4 an extremely powerful and flexible system. Systems may comprise a single standalone node, while larger installations comprise an integrated network. These may include many nodes communicating via IPv6 over several different types of fire-listed wiring, including fiber optics, twisted pair, and CAT5 cabling. Regardless of the system size, a single 4-CPU node controls up to 19 additional local rail modules.

The 4-CPU controls all local panel responses to automatic, user initiated, or network-reported events. As a network node, it is an equal among peers: there is no master on the network. This gives exceptional response times of less than three seconds.

Intra-module Communications

Upon power-up the processor automatically learns all local rail module attributes and locations; it negotiates with other life safety CPUs at nodes on the IPv6 network; and, it automatically enables the full support for cyber security protocols tested to meet FIPS Publication 197. This security applies optionally to a single panel, or throughout the entire EST4 network. The 4-CPU automatically configures the EST4 network thanks to integrated plug-and-play setup and auto address. No IT network administrator is required.

The EST4, 4-CPU on-board USB ports make inner panel wiring simple. The majority of interconnections are made with standard USB 3.0 cables supplied as standard with most option modules. The USB interconnect runs at speeds of up to 480 Mbps, ensuring fast system data transmission.

This fast data transmission is used, not only for inner panel communication, but also for external communications through a 4-FWAL to the FireWorks graphical user interface, printers, and other systems needing integration to the life safety system.

Inter-Panel Neworking

Each 4-CPU provides two SFP slots supporting hot-swappable modules that determine the media type in use at the panel. The 4-CPU also supports the 4-AUDTELS Audio Telephone Riser Module. This enables audio, local microphone connection, and firefighter telephone connection. The 4-CPU supports connection of optional common relays, 1 Vrms audio in- and out-terminals, and firephone riser connection — all of which provide removable field wiring terminal blocks.

For enhanced survivability, SFP network controller modules are hot swappable and mount to the slots on the 4-CPU. The network connection supports panel-to-panel data, voice audio, and firefighters telephone all on the same cabling – no separate interconnections needed. Should the application call for it, cabling can be installed that allows all inter-panel network data – including panel data, voice audio, and firefighters telephone – to be transmitted on a single twisted pair or single fiber optic fiber. This helps speed setup time and cuts installation costs.

Network physical interconnection options offer a range of solutions from twisted pair running at 2 Mbps and supporting distances of up to 5,000 ft. (1.5 km) between any two panels. When running at 0.2 Mbps, even longer distances are possible – up to 50,000 ft. (15 km).

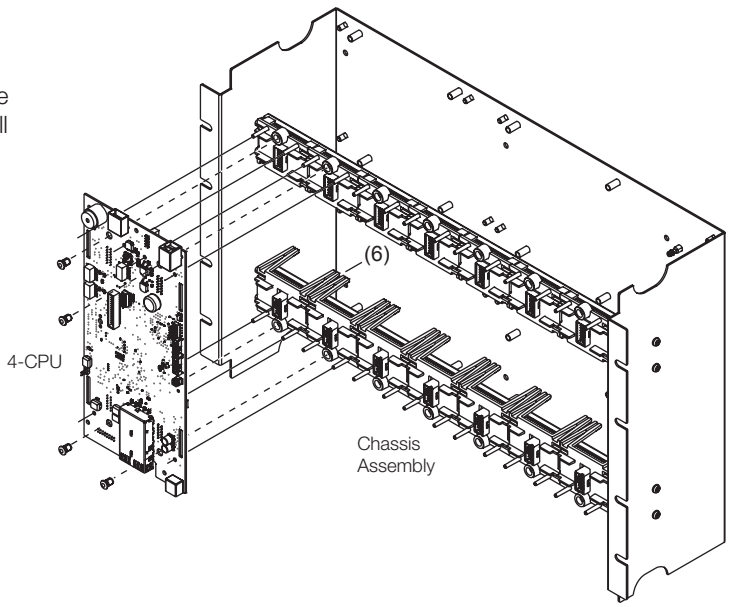
Single-mode, multimode, and even CAT5 cabling options are possible with EST4. The 4-CPU also meets redundancy and survivability requirements of many cabling needs, including Class A, Class B, Class X, and Class N. CAT5 installations are not limited to Class N wiring style: the network can be engineered to meet Class A, Class B, and Class X configuration when the project requires distances of up to 3,280 ft.

Network messages received by the network communications controllers are re-transmitted to the next network panel. This re-transmission maximizes the wire run lengths between panels.

Should the related central processor stop operating to specifications, fail-safe protocols built into EST4 network controller cards connect the data input directly to the output ports. This operation provides a back-to-back passthrough mode for most media type to media type and maintains network connectivity, not only during a catastrophic failure of a single panel, but also in the event that the panel is powered down for servicing. This keeps the fire network up and running at all times. For greater serviceability, any powered-down panel maintains its real time clock for up to 30 minutes — even if the panel has all power sources removed, including main and standby sources.

Installation

The 4-CPU mounts in the first two local rail spaces of the upper 3-CHAS7 module chassis. Options for the 4-CPU include a color LCD display and user interface, a wide selection of small form-factor pluggable (SFP) network controller modules, USB internal panel connections, common relays, audio, and fire fighters telephone communication cards.



Engineering Specification

It must be possible to support a single standalone node or multiple nodes communicating on a TCP/IP, IPv6 network that supports mesh configuration. The network shall support physical media connections via fiber, twisted pair or CAT 5 in any combination. The Network shall support data transmission of panel-to-panel data, voice audio and firefighter telephone data on a single twisted pair or single fiber optic cable. The Network shall be configured as Class A or Class B or Class X configuration. Networks restricted to Class N wiring shall not be acceptable. Network shall support a back-to-back pass-through mode that shall maintain network connectivity on power down or catastrophic failure of a single panel. The network shall support twisted pair links to 5,000 ft., CAT 5 links to 3,280 ft., and fiber links to 130,994 ft.

The network shall support hard copy report printing to a system printer connected to any panel in the network, systems that require reports be run from the panel that has a printer connection shall not be considered equal. The systems LCD display shall provide color graphics display of maintenance and sensitivity reports.

The system shall support multiple languages/dialects and Unicode character set.

The Control panel and network shall not use easily removable devices, such as SD cards or external storage devices for storage of system critical information including programming and project files. Communications outside the life safety network shall meet the requirements of FIPS Publication 197.

Security-relevant information, such as: failed login attempts, failed unauthorized accesses, and user modification shall be logged to panel history. Unsuccessful authentication attempts shall not leak information regarding the presence of the system or users. Credentials shall only be transmitted that are encrypted. The system shall provide for multiple users, roles shall be provided for users to ensure proper access by user for the role they perform on the system. All passwords shall use a cypher algorithm for security purposes to protect any sensitive information. No passwords shall be visible as plain text within the database or entire system.

Sensitive information shall not be logged to history or displayed on service tools (e.g. passwords, PINs etc.).

The system shall support configuration of multiple IP connections to external services including, central stations, email servers, web interfaces, reports, and third party integration.

Email messages shall support multiple languages in native characters that match the languages supported in the panel. Email messages shall support symbolic and color alarm event highlighting.

The system shall support logging of up to 20,000 chronological events using FIFO. Is shall be possible to freeze or store the most recent 10,000 events separately from the FIFO log.

It shall be supported to download all applications and firmware from the configuration computer at a single location on the fire network. The system shall support upload of a project file from any location on the fire network.

Technical Specifications

Current Standby Alarm	230 mA at 24 VDC
Common relays	See the 4-COMREL Common Relay Module Installation Sheet (P/N 3102284- EN)
Universal Serial Bus (USB) ports	1 USB 3.0, Type A – female port 1 USB 3.0, Type B – female port
USB cables[1]	4-CABLUSBSM – 3.0 USB, 29.5 in.(0.75 m), included. 4-CABLUSBLG – 3.0 USB, 59.0 in.(1.5 m), sold separately.
SFP modules	Refer to the SFP catalog sheet E85014-0008 for a list of compatible SFP modules.
Agency Approvals	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept. [2]
Wire size TB1 network backup power connection	12 to 18 AWG (2.5 to 1.0 mm^2)
Ground fault impedance	5 kΩ or less
Operating environment Temperature Relative humidity	32 to 120°F (0 to 49°C) 0 to 93% noncondensing

[1] Only use listed USB cables. Retail USB cabling is not sufficient for this application.
[2] CE compliant product add suffix -E to model (e.g. 4-CPU-E)

Ordering Information

Model # (SKU)	Description	Shipping Weight
4-CPU	Central Processor Module	0.95lb (0.43kg)
4-CPU-E	Central Processor Module, EN54 compliant model	0.95lb (0.43kg)
4-AUDTELS-E	Audio and Telephone Interface/Riser Source Module, EN54 compliant model	0.95lb (0.43kg)
Accessories and related equipment		
4-AUDTELS	Audio and Telephone Interface/Riser Source Module	0.65lb (0.29kg)
4-COMREL	Common Relay Module	0.25lb (0.11kg)
4-NET-MM	SFP Network Controller, Multimode, Dual-Fiber, 100Base-FX 1310nm	0.248lb (0.112kg)
4-NET-SM	SFP Network Controller, Single-Mode, Dual-Fiber, 100Base-LX10 1310nm	0.248lb (0.112kg)
4-NET-SMH	SFP Network Controller, Single-Mode, high power output, Dual-Fiber, 100Base-LX40 1310nm	0.248lb (0.112kg)
4-NET-TP	SFP Network Controller, 2Mbps Shared TX/RX, Twisted Pair	0.2lb (0.091kg)
4-NET-TP-HC (Not approved for EN54 applications)	SFP Network Controller, 0.3Mbps Shared TX/RX, High Capacitance Twisted Pair	0.2lb (0.091kg)
4-NET-CAT	SFP Network Controller, CAT5 UTP Copper, 100Base-TX	0.2lb (0.091kg)
4-NET-SMD	SFP Network Controller, Single-Mode, Single-Fiber, Downlink, 100Base-BX10-D 1550nm/1310nm Tx/Rx	0.248lb (0.112kg)
4-NET-SMU	SFP Network Controller, Single-Mode, Single-Fiber, Uplink, 100Base-BX10-U 1310nm/1550nm Tx/Rx,	0.248lb (0.112kg)
4-USBHUB	USB Multiport Hub Module	0.85lb (0.39kg)
4-CABLUSBLG	Cable, USB 3.0 A-B, Male, Long	0.31lb (0.14kg)
4-CABL0542	Cable interconnects the 4-CPU to the inner door rail when no 4-LCD display is installed in the cabinet.	0.58lb (0.26kg)

Note 1: Unless otherwise specified, all SKUs may be used in EN54/UL/ULC applications.

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EST4 LCD Display Module

4-LCD Series



FM APPROVED | NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL | UL | ULC | CE | EN54

Overview

EST4's LCD large color touch-screen display is the window into system operation and maintenance functions. It is large enough to support a graphical tree view of the system. The tree closely matches the system's physical layout, so there's no need for look-up tables to find specific devices. This is invaluable to technicians and building service personnel who can pinpoint the location of an off-normal device with a glance at the on-screen tree.

The EST4 LCD screen will display eight events without scrolling. In addition to touch-screen capability, the display assembly includes four dedicated easy-access rubber buttons for main control functions.

On the display, device events automatically sort into classification queues with event counts for easy identification and response. When new events are present that have yet to be reviewed, each queue is highlighted with an visual marking.

Standard Features

- **Large Easy-to-Read Display Area**
  Displays eight events, 768 10-point characters.
- **Full Color for Detail-rich User Experience**
  262,144 colors with support for custom wallpaper.
- **Displays System Tree View on One Screen Page**
  Quick drill-downs to find devices, no look-up tables required.
- **Context-sensitive User Interface**
  One sign-in determines user privileges and available devices.
- **Color-coded Event Queue, History Log, Status Report**
  At-a-glance identification of priorities.
- **User Configurable Image Display**
  Displays a customized image that appears on the LCD's home screen when no active events are present.

DATA SHEET E85014-0007
Not to be used for installation purposes. Issue 3.0

Application

Ensuring information clarity, the 4-LCD uses a 262,144 color touch screen LCD display. The display's design layout provides not only emergency information in a useful format, but also the ability to view other system operations including reports. A single button press will route the report to a configured network printer for hardcopy record of the report.

The 4-LCD always displays the last highest priority event. Further message flexibility is provided with EST4's message routing ability. Messages from a panel can display at every LCD on the network, or messages can route to specific LCDs only. Routing can be initiated at a specific time/shift change. There is no need to have messages display in areas that are not affected by an event.

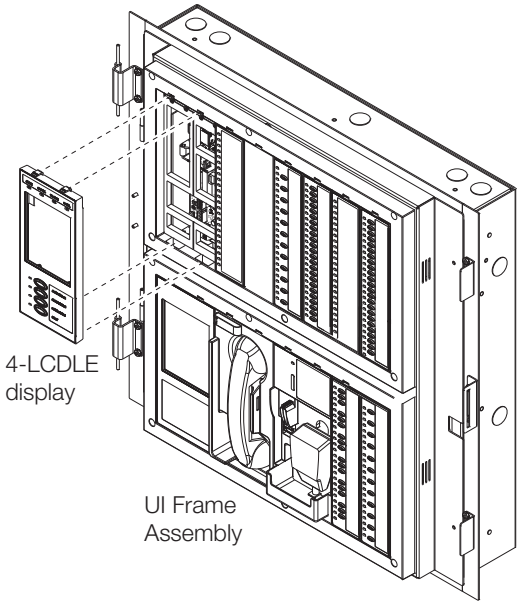
The 4-LCD can display system messages in any two of the EST4-supported languages and dialects. Choice of language is selected by the marketplace setting in EST4, any two of the available languages for a marketplace can be displayed as the primary language, and a second language can be displayed simply by selecting the language button on the LCD display. The display supports a set of Unicode symbols for example: ☢ ☣ ☤ ☠ . These symbols can provide a heightened visual element to a messages importance.

Assembly and Installation

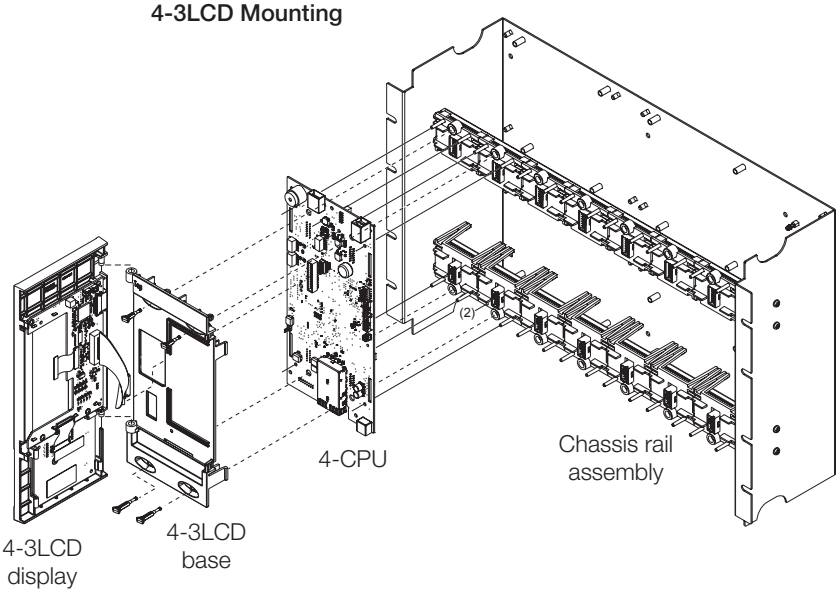
The 4-LCD display mounts onto the inner door frame of EST4 control panels. The inner door also acts as a deadfront, separating users from field wiring located behind it.

The 4-3LCD display mounts into EST3 enclosures that do not contain audio control components. This allows reuse of EST3 user interface layers in these applications. The 4-3LCD mounts onto the top of the 4-CPU in EST3 retrofit applications, providing all the benefits of the 4-LCD, while matching closely the EST3 look.

4-LCD Mounting



4-3LCD Mounting



Engineering Specification

The system shall provide a user interface that displays system events on a color touch screen display in a text format. The display must be capable of supporting a minimum of two languages including but not limited to English, Spanish, Portuguese or French. The display design shall be simplified for emergency users so that main common controls are provided as switches/buttons that provide positive feedback of operation, common control buttons shall not be part of the touch screen display area. The Common Control Switches and LEDs provided through tactile buttons with indicators shall be; Reset switch and LED, Alarm Silence switch and LED, Panel Silence switch and LED, Acknowledge switch and LED. In addition the following LEDs shall be provided as discrete indicators, Alarm Indicator, CPU Fail Indicator, Trouble Indicator and Power Indicator. It must be possible to add additional common controls as required through the use of modular display units. The user interface must provide a color touchscreen LCD display with minimum resolution of VGA 640 x 480. The display shall provide a minimum of seven events displayed concurrently and support >200,000 colors. The system shall be capable of displaying custom images on the panel's LCD screen when no active events are present. Hands free operations shall be provided for viewing the first eight highest priority events. Events of different priorities shall be automatically placed in easy to access queues. It shall be possible to view specific event types separately. Having to scroll through a mixed list of event types is not acceptable. The total number of active events by type must be displayed. Visual indication must be provided of any event type which has not been acknowledged or viewed. It must be possible to customize the designation of all user interface LEDs and Switches for local language requirements. The color LCD display must support scripts & ideograph style font types. It shall be possible to have a custom message for each device in addition to zone messages. Custom device messages must support a minimum of 42 characters each. Instructional text messages support a maximum of 2,000 characters each.

Control and Display Functions

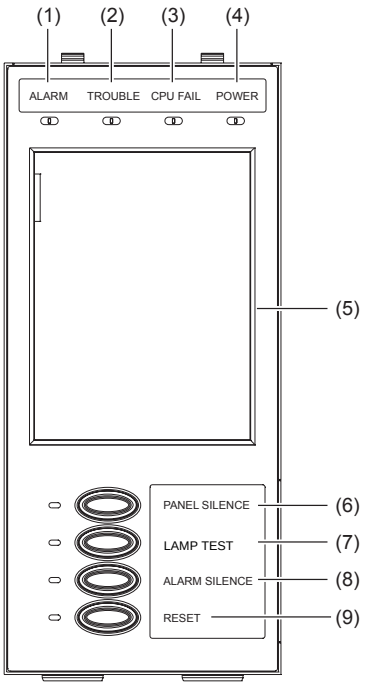
The EST4 LCD display simplifies the user interface. Up front and at the top of the display are four easy-to-read and understand status lights.

1 Alarm LED

The Alarm LED serves as a common alarm event indicator. The LED illuminates when there is am Alarm type event on the system. The specific Alarm event displays in its queue on the LCD where a count of alarm events is displayed along with a visual indicator if there are new events that have not been viewed.

2 Trouble LED

This LED serves as a common trouble event indicator. The LED illuminates when there are events in the trouble event queue located on the LCD display. The trouble event queue provides a count of trouble events and highlights if there are new events that have not been viewed (local systems operation) or acknowledged (proprietary systems operation).



3 CPU Fail LED

The LED indicates that the CPU has detected a processor failure. Processor failures must be reset manually using the Reset button.

4 Power LED

The LED indicates the power status. The LED operation is selectable in the panel configuration utility and supports local power display requirements including: On if there is primary or standby power present; On when primary power present, off during primary power loss; On when the panel has primary power and standby power, off if either standby or primary power are absent.

5 LCD screen

The heart of the 4-LCD is the color Liquid Crystal Display located in the center of the module. In the System Normal condition the date and time plus system wallpaper image are displayed on the LCD.

Control Buttons

Four easy to find rubber buttons are located at the bottom of the display. These provide simple-to-understand common control functions. The switch design gives tactile feedback when operated, but EST4 offers additional user feedback by also providing a visual indication of switch activation through the associated LED. When a switch is activated the LED beside the switch will illuminate in a contrasting color. This gives a visual indication that the system has seen the switch push. The LED will change to its programmed color when the switch command has been executed.

The versatility of EST4 allows system designers to define the features affecting particular areas of a building. These are known as Notification Control Areas (NCAs), which are defined areas of an installation. A network may have several NCAs. This feature is very useful when configuring systems with multiple buildings on one network. For example, operating the Reset function in one building may have an adverse effect in other buildings. As a solution to this, audio paging may be programmed to affect the defined NCA and no other NCAs. This means that with EST4, having operational differences between buildings on the same network is not a problem. This feature can save wiring and reduce inter panel overhead.

6 Panel Silence button and LED

The factory default for this programmable button and LED indicator is Panel Silence. Pressing Panel Silence turns off the system's internal audible signal. The switch indicator has two statuses: white when the switch is pressed, yellow on when panel silence is active.

~~7 Fire Drill button and LED~~ Make this Lamp Test

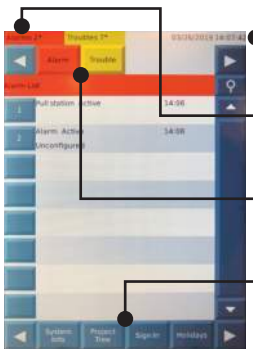
The factory default for this programmable button and LED indicator is Fire Drill. Pressing Fire Drill turns on the drill LED and all signals sound evacuation. Drill does not activate city tie connections. Auxiliary relays will not activate unless programmed to do so with drill.

8 Alarm Silence button and LED

The factory default for this programmable button and LED indicator is Alarm Silence. Pressing Alarm Silence turns off all Notification Appliance Circuits defined as audible. The switch indicator has two statuses: white when the switch is pressed, yellow when silence is active via the Alarm Silence switch or via alarm silence software timers.

9 Reset button and LED

The factory default for this programmable button and LED indicator is Reset. Pressing Reset starts the system's reset operation. The switch indicator has four statuses: white when the switch is pressed; fast flashing green during the smoke power down phase of reset; slow flashing green during the restart phase; and, on steady green during the restoral phase. The Reset LED is off when the system is not in the reset process.



a. Date and Time: Date format is selectable in the 4-CU.

b. Event Indicators: The event indicators provide a quick view of the event types active in the system. It indicates a count of the number of events in each group, and highlights new events that have not been viewed.

c. List Bar: The List Bar shows the event queues with active points. By simply selecting a queue the events for that queue are displayed in a list on the screen. In this example, the alarm queue is displayed.

d. Action Bar: The Action Bar allows the selection of specific actions that can be initiated via the LCD. Among those actions are gaining access to higher function levels (with proper accreditation), changing to the graphical Tree View, or accessing information such as panel firmware versions, CU and hardware configurations, licensing and contact information.

LCD screen

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Technical Specifications

	4-LCD	4-3 LCD
Rail Spaces	Two inner door spaces	Two user interfaces spaces.
Mounting	Mounts on inner door	Mounts on UI layer above 4-CPU
Current		
Standby	50 mA at 24 VDC	
Alarm/active	110 mA at 24 VDC	
Display	18 bit color. 640 x 480 pixels, resistive touch screen	
System status indicators		
ALARM	Red indicator	
TROUBLE	Yellow indicator	
CPU FAIL	Yellow indicator	
POWER ON	Green indicator	
Common controls and indicators [1]		
PANEL SILENCE button	Yellow indicator integrated with the Panel Silence button	
FIRE DRILL button	Yellow indicator integrated with the Fire Drill button	
ALARM SILENCE button	Yellow indicator integrated with the Alarm Silence button	
RESET button	Green indicator integrated with the Reset button	
Operating environment Temperature	32 to 120°F (0 to 49°C)	
Relative humidity	0 to 93% noncondensing	
Custom Background Image	Size: 480 x 640 pixels or greater with as aspect ratio of 3:4 (e.g., 600 x 800, 768 x 1024, or 960 x 1280) Resolution: 141 dpi or greater Color depth: 18-bit color or greater (24-bit is RGB; 32-bit is CMYK) Format: JPG, JPEG, or PNG	

[1] Factory default for the common controls and indicators are listed here. These common controls can be reprogrammed using the Configuration Utility (4-CU). The associated indicators can also be reprogrammed as red, green, yellow, blue or white colors.

Ordering Information

Model # (SKU)	Description	Shipping Weight
4-LCD	Main color touchscreen LCD display	1.25lb (0.57kg)
4-LCDANN	4-LCD w/ cable for Annunciator enclosure 4-4ANN, 4-6ANN mounting	1.9lb (0.85kg)
4-LCDLE	4-LCD w/ cable for 3-CAB5B, 7B, 14B, 21B, 4-8ANN, 16ANN and 24ANN mounting	1.9lb (0.85kg)
4-3LCD	LCD display for use in EST3 panels, allows reuse of EST3 UI layer in retrofit applications. The 4-3LCD can be mounted in remote closet cabinets where an LCD display is needed. The display mounts on the 4-CPU module.	1.5lb (0.66kg)
4-3LCD-E	LCD display for use in EST3 panels, allows reuse of EST3 UI layer in retrofit applications. The 4-3LCD can be mounted in remote closet cabinets where an LCD display is needed. The display mounts on the 4-CPU module. EN54 compliant model.	1.5lb (0.66kg)
Accessories and related equipment		
4-CABL0502	Service replacement cable, 4-LCD to 4-CPU flex interconnect cable for CAB5, 7, 14, 21.	0.38lb (0.17kg)
4-CABL0504	Service replacement cable 4-LCD to 4-ANNCPU cable for use in 4-2ANN, 4ANN, 6ANN annunciator configuration.	0.37lb (0.17kg)
4-CABL0541	Service replacement cable 4-3LCD to 4-CPU cable for use in 3-CAB5B, 7B, 14B, 21B, RCC series.	0.1lb (0.04kg)
4-CABL0505	Cable, Door Rail to Rail, 13 Inch for 4-CAB16D(R), 4-CAB24D(R), or 4-CAB24D(R)L.	0.5lb (0.23kg)
4-CABL0507	Cable, Door Rail to Rail, 11.3 Inch for 4-CAB8D(R).	0.5lb (0.23kg)
4-CABL0542	Cable, for use with 4-CPU or 4-ANNCPU where no LCD is installed on Inner Door.	0.6lb (0.26kg)
4-LKIT-ES	Language Kit, 4-LKIT-ES, Panel door, Spanish, Edwards	25lbs (.11)
4-LKIT-FR	Language Kit, 4-LKIT-FR, Panel door, French, Edwards	25lbs (.11)
4-LKIT-PT	Language Kit, 4-LKIT-ES, Panel door, Portuguese, Edwards	25lbs (.11)
4-LKIT-ZH	Language Kit, 4-LKIT-ES, Panel door, Chinese, Edwards	25lbs (.11)

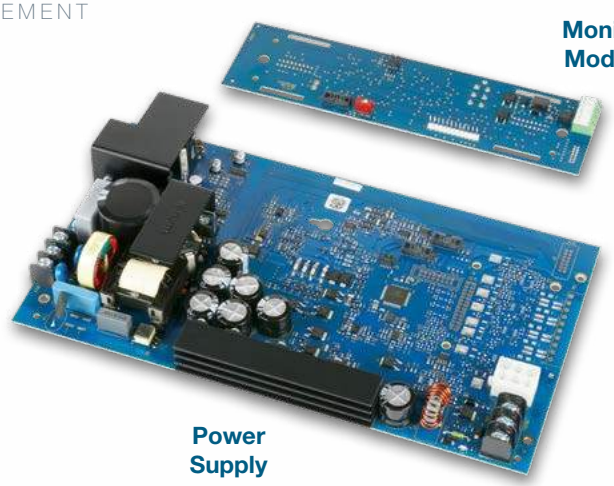
Note 1: Unless otherwise specified, all SKUs may be used in EN54/UL/ULC applications.

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

System Power Supplies

4-PPS/M series



Approvals

EST4	EST3
S3000	S3000
7300-1657: 0519	7300-1657: 0519

Overview

System power supplies consist of two assemblies, a high efficiency switch mode power supply card and a power supply monitor module. The monitor module mounts to the local rail and distributes the power from its supply to the local rail. The local rail distributes power from all power supplies to other local rail modules and user interface cards resulting in “Shared Power” throughout the system. The 4-PPS/M can be configured as a primary power supply (PPS), booster power supply (BPS), or booster charger (BBC).

A 4-PPS/M configured as the PPS provides filtered, regulated power to the rail chassis modules as well as 24 VDC for operating ancillary equipment. The PPS consists of a power supply unit (PSU) mainboard and a monitor (MON) module.

Each booster power supply consists of the PSU mainboard and MON module. The booster power supply MON module provides the interface between the booster and the panel, making the required data and power connections to and from the rail chassis.

Maximum use of available power is achieved by configuring the power supplies in parallel. This results in a potential reduction in the number of power supplies necessary to meet requirements.

As many as four power supplies combined in a single enclosure provide up to 28 amps of available power. Battery backup is provided using one to four sets of batteries, depending on standby power requirements.

System power supplies mount to the back of the chassis units or wallboxes. Access to auxiliary power is via easily accessible terminal blocks located on the power supply monitor module. Each power supply produces 7 Amps of filtered and regulated power.

With four power supplies located in an enclosure (one primary and three booster power supplies) 28 amps of current is available for local rail modules, control display modules and the eight auxiliary 3.5 amp power outputs (two per supply).

Standard Features

- High efficiency switch mode
- Increased power distribution efficiency - power supplies parallel allowing up to 28 amps in a single node
- Universal 120 to 240 VAC Operation
- 7 AMP filtered and regulated
- Two 3.5 AMP outputs
- Temperature compensated, dual rated battery charger
- Electronic power limiting
- Automatic load testing of batteries
- Fully approved to UL/ULC standards

DATA SHEET E85010-0060
Not to be used for installation purposes. Issue 1.3

Application

The primary power supply provides the system with battery charging and voltage regulation. Software configures the charger to either 10-24 AH batteries or 30-65 AH batteries and controls the high/low charge rates. Batteries mounted in the same enclosure as the power supply, have their charge rate monitored and adjusted based on the local enclosure temperature, keeping charging rates within battery specification. For remote batteries a temperature probe is monitored in the remote battery cabinet and charge rates are adjusted automatically. Battery damage is unlikely to occur when environmental short term conditions are outside of normal operating ranges.

The 4-PPS power supplies automatically load test batteries by shutting down the battery charger and placing a load across the battery. If the battery voltage is outside the specification range the power supply reports a trouble. The trouble clears if the battery is able to recover and pass future load tests.

Battery leads are electronically short circuit protected. If a short occurs in the battery leads the charger automatically disables itself and causes a trouble. The system will constantly look to see if the short has cleared. If the short clears, the system automatically restores.

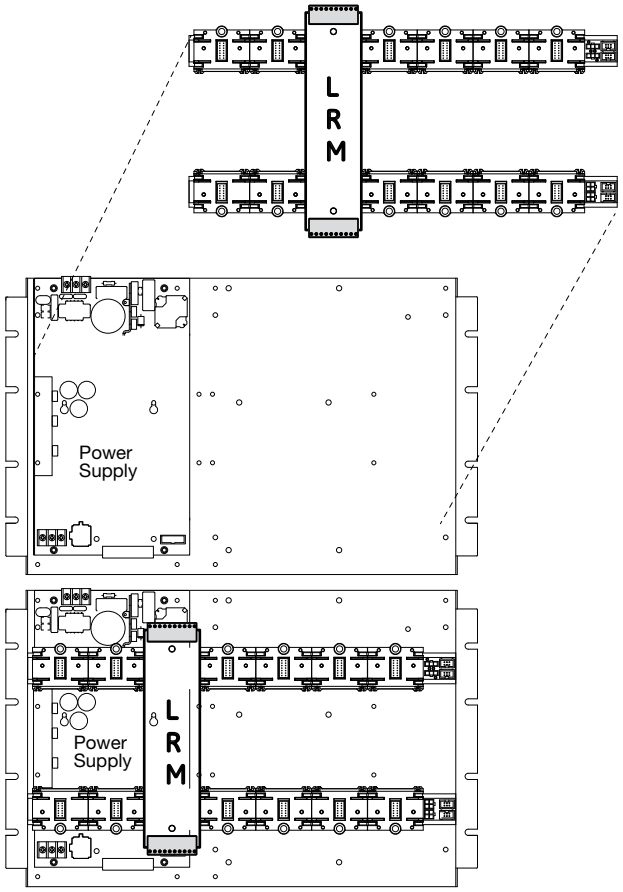
During operation on standby batteries, battery voltage is constantly monitored. A trouble is reported if the battery voltage falls below a specified value.

4-PPS power supplies provide specific information back to the CPU designed to help speed trouble shooting of system functions. Should a power supply detect a fault, specific diagnostic codes are available to speed trouble shooting. The LCD will display the power supplies address, a specific trouble code, and a text message describing the specific trouble. Text messages are easy to understand and include items like: Battery Trouble, Aux Power Overload Circuit 1, Aux Power Overload Circuit 2.

Engineering Specification

The fire alarm power supplies must be capable of being paralleled and to load share. Multiple power supplies must be capable of being backed up with a single 24 volt battery set. Each power supply shall be capable of charging up to 65 AH batteries. The power supply must be able to perform an automatic load test of batteries and return a trouble if the batteries fall outside a predetermined range. Power supplies must incorporate the ability to adjust the charge rate of batteries based on ambient temperatures. It shall be possible to adjust for ambient temperature changes in local cabinets as well as remote cabinets.

Installation and Mounting



Power Supply Rules

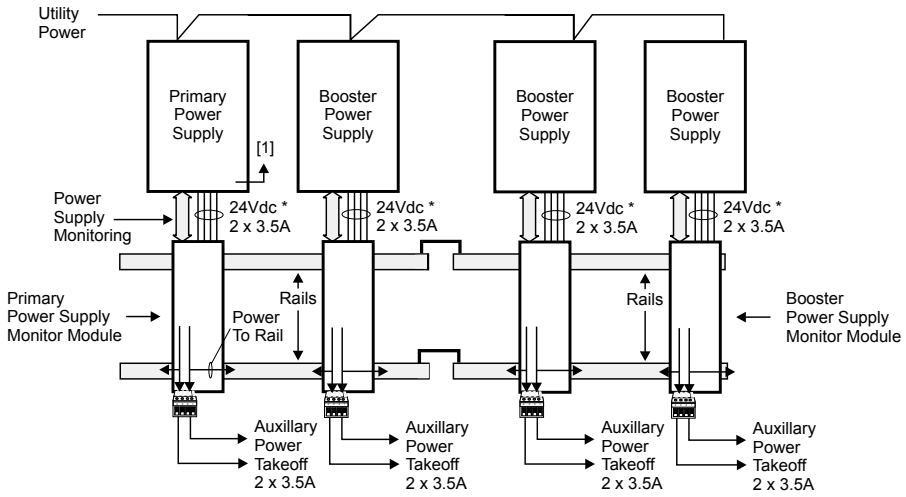
1. **<u>Equipment damage</u>: Do not install the 4-PPS/M in the same cabinet as a 3-PPS/M, 3-BPS/M, or 3-BBC/M. Combining the 4-PPS/M with legacy power supplies will cause damage to the power supply.**
2. Each battery set needs one charger.
3. Each power supply must be connected to a battery set using an identical length and gauge of wire to keep voltage drops identical.
4. Distribute power supplies and loads evenly across rails.
5. **All battery sets for a panel must be the same capacity (AH), same manufacturer, and same manufacturing date code.**

The Table below illustrates the combinations of power supplies and batteries that meet all the power supply rules.

24 VDC Power Supply Output Current

	7A	14A	21A	28A
Battery Requirements	One Set, 40 AH max	Two Identical Sets, 65 AH max	Three Identical Sets, 65 AH max	Four Identical Sets, 65 AH max
Required 4-PPS/M Modules	1	2	3	4

Typical Wiring



[1] From battery temperature probe terminals.

* Nominal Voltage

Specifications

Catalog Number	4-PPS/M
Agency Approvals	UL, ULC
Input Voltage	120-240 Vac (+10%, -15%), 50-60 Hz
Brownout Level	< or = 96 Vac
Current Requirements	PPS Included with CPU current requirements BPS/BBC Alarm: 45mA; Standby: 45mA
Input Current	3.0 A
Total Output	Special applications Total Internal DC Auxiliary DC*
Battery Charging Capacity	65 AH Sealed Lead-Acid
Low Battery Trouble	22.5 Vdc
Deep Discharge Cutoff	19.5 Vdc
Mounting Requirements	1 LRM space, 1 chassis footprint
Wire size (TB1 and TB3)	12 AWG to 20 AWG (4.0 mm^2 to 0.75 mm^2)
Output Protection	Electronic power limiting & heat sink temperature
Ground Fault Detection	< 10K Ohms

Ordering Information

Catalog Number	Description	Ship Wt., lb. (kg)
4-PPS/M	Primary Power Supply w/ local rail module 120-240V 50/60 Hz	5 (2.3)
3-BTSEN	Distribution Module required when battery installed in remote cabinet	.5 (.22)
4-FIL	Blank EST4 filler plate (order separately when no LED or LED/ Switch module is installed on the inner door).	0.1 (0.05)
3-FP	Filler Plate, order separately when no LED or LED/Switch module installed.	0.1 (0.05)

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LIFE SAFETY & INCIDENT MANAGEMENT

Zoned Audio Amplifiers

3-ZA20A, 3-ZA40A, 3-ZA95



FM APPROVED · NYC FIRE DEPT. COA # 6314 · UL · ULC · 7165-1657: 0186

Overview

EST4 audio amplifiers take full advantage of proven digital technology to deliver highly intelligible voice audio for evacuation and Mass Notification purposes. Pre-Recorded digital messages and live paging messages are multiplexed into separate channels. Each zoned amplifier contains integrated de-multiplexing circuitry that allows eight digital audio channels, designated from the 100 system-supported channels, to be placed on the amplifier's built-in speaker circuit.

Audio channel selection is made at the control panel with all pre-recorded messages stored locally. This means there is no need to rely on network data transmissions of prerecorded messaging. The panel always plays the message for events based on the event, which ensures fast selection and reliable playback.

Audio amplifiers mount in the same enclosures as other EST4 equipment. Power for the amplifiers comes from standard system power supplies through the local rail.

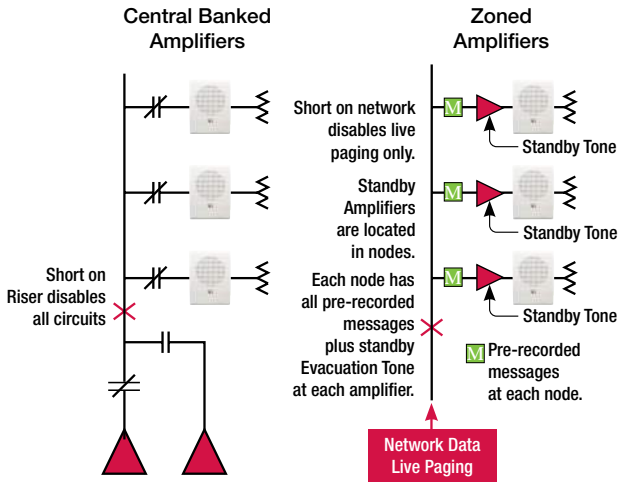
Field wiring connects to removable terminal blocks on the amplifier module. Amplifiers support either 25 VRMS or 70 VRMS power limited speaker circuits. For visual signalling, each 20 or 40 watt amplifier comes standard with one 24 Vdc power limited Notification Appliance Circuit.

Standard Features

- **Three Sizes Available**
  -20 Watts
  -40 Watts
  -95 Watts
- **Simultaneous eight channel digital audio**
  - Superior sound quality
  - Each amplifier does it's own decoding
- **Speaker circuit built into amplifier**
  - Selectable for 70 or 25 VRMS output
  - Class A or Class B output
  - Power limited
- **3.5 amp 24 Vdc notification appliance circuit on 20 and 40 watt amplifiers**
  - Class A or Class B output
  - Power limited
- **Integral backup tone generator**
  - 1 KHz temporal (3-3-3) tone evac
- **Part of an end-to-end 520 Hz signaling solution**
  - UL 464/864 approved for use in sleeping rooms

Application

EST4 zoned amplifier configurations offer improved reliability and performance. Configuration provides improved survivability in the event of wiring faults that result in a loss of signalling. In the example shown in the diagram, a fault on the system using a central backed-up amplifier disables multiple signal/page circuits, and the standby amplifier is not able to bypass the fault. With EST4, the same fault cannot occur, as there is no audio riser. All prerecorded messaging resides in the node where the amplifiers are mounted.

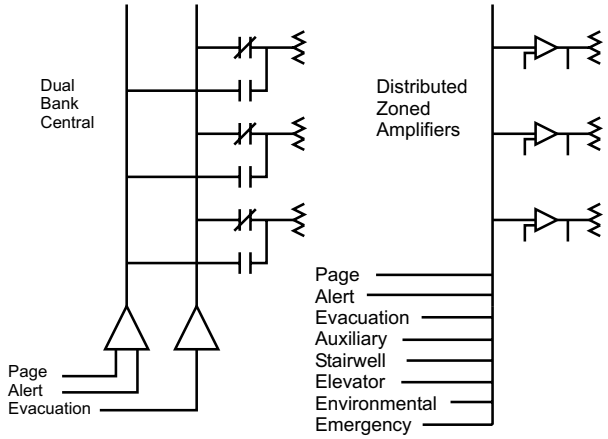


Because all EST4 nodes store their pre-recorded messages locally, programmed messages will become active when a locally generated alarm is initiated — even when a catastrophic network failure has taken place. Additionally, zoned amplifiers have integrated 1000 Hz temporal tone generators that will produce a backup signal should the main CPU suffer a catastrophic panel failure. Meanwhile, a single standby amplifier can backup any zoned amplifier in the same cabinet. These layers of redundancy provide a level of system survivability that keeps life safety measures in place, even under the harshest conditions.

EST4 easily outperforms banked audio systems and many zoned amplifier systems with its ability to simultaneously deliver up to eight of a possible 100 audio channels to each node. When using centrally-banked amplifiers, paging and alert channels typically share a common amplifier. Consequently, when paging, the alert signal goes silent in all alerted areas when a Page is issued. At the end of the Page, the alert signal resumes in the alert area. This could cause confusion because occupants will not have received the page message and do not know why the alert signal was interrupted. In zoned amplifier systems that support fewer channels, it is possible to run short of available channels — particularly in large campus networks or high rise networks where there is a need to support larger numbers of specific messaging.

With EST4, simultaneous Page, Alert, and Evacuation signal capability is engineered into the system. With 100 channels to choose from, up to eight channels can be delivered to a single node, allowing dedicated messages to be delivered to stairwells, elevator cabs, etc., while Alert, Evacuation, and Page instructions are simultaneously being sent to other areas.

Eight specific audio channels can be selected for each node. This allows messages to be automatically routed and programmed to provide specific instructions based on the alarm's location. At the same time, other areas can access and play a different eight audio messages.



For example, with an alarm on Floor Eight, the following automatic message instructions could be given concurrently. **Note:** A Page could also be sent to any other location in the building – without interrupting any of the messages below.

FLOOR 9 HEARS: "A fire alarm has been reported on the floor below. Please evacuate using the stairwell."

FLOOR 8 HEARS: "A fire alarm has been reported on this floor. Please evacuate using the stairwell."

OTHER FLOORS HEAR: "An emergency has been reported on floor 8. Please remain in the building and await further instructions."

ELEVATOR: "A fire alarm has been reported in the building. The elevator is being returned to the ground floor for emergency use. Please evacuate the building."

STAIRWELLS: "Please remain calm and walk down the stairs to evacuate the building in a safe manner."

In addition to robust paging, EST4 provides UL-listed Mass Notification, which overrides fire alarm functions. This capability allows emergency response commanders to advise building occupants of the safest action to take while an emergency is unfolding. Occupants can be instructed to leave, relocate, or seek immediate shelter, depending on the situation. This provides the flexibility for communications to mesh with the facility's risk analysis needs — without an unexpected fire alarm or general evacuation signal interfering with established emergency response protocols.

For buildings designed to allow elevators to be used for Occupant Evacuation Operation (OEO), EST4 can integrate with elevator controllers to provide specific messaging associated with the use of elevators for evacuation.

Sleeping Areas

3-ZA Series Amplifiers are part of an end-to-end low frequency solution listed to UL 464 and UL 864. It is approved for code-compliant 520 Hz signalling in sleeping areas when used in conjunction with:

- an EST4 control panel
- a factory-supplied 520 Hz audio file
- one or more Genesis High Fidelity speakers

Consult the EST4 System Compatibility List for full details of compatible devices.

Engineering Specification

Provide emergency audio as part of the main fire alarm control panel. The emergency audio shall contain a paging microphone and zoned amplifiers capable of delivering multi-channel audio messages. The system shall support a minimum of 100 audio channels. Transmission of live paging audio shall be over the same data network wiring as the fire panel data. The network data transmission shall be over a dedicated <single copper pair> <dual multi-mode fibers>, <dual Single mode fibers><one single mode fiber> to remote parts of the facility. Prerecorded messages shall be stored locally at each node. Transmission of prerecorded audio across the network during alarm events is not acceptable.

For systems requiring multiple locations for paging, the ability to Request/Grant/Deny page privileges shall be supported. Priorities shall be configured in software covering the operational priorities between Autonomous Control Units (ACU), Central Control Station (CCS) and Local Operators Consoles (LOCs). As a minimum the system shall consist of: Local Page, Emergency Communication, Multiple Evacuation, Alert, Auxiliary, and General Signalling. Channels shall support hierarchical operation and be controllable from system programming. The audio system shall also provided Elevator, Stairwell and Auxiliary signalling. Systems that cause signalling devices to go silent while performing any signalling functions will not be accepted. The system shall support repeat counts of audio messages, as well as stacking of audio messages in a FIFO configuration.

The audio system zoned amplifiers must be able to operate 25 VRMS or 70 VRMS speakers. The amplifier output must be power limited, and wired in a <Class A> <Class B> configuration. The amplifiers shall source prerecorded messages locally, and shall not have to rely on network communications to receive prerecorded messaging. Should local audio be unavailable the amplifiers shall provide an integral backup 1000 KHz temporal tone generator which shall operate in the event primary audio signals are lost and the amplifier is instructed to broadcast alarm information. It shall be possible to backup multiple zoned amplifiers with a common backup amplifier.

Technical Specifications

	3-ZA20A	3-ZA40A	3-ZA95
Agency Listing	UL, ULC, FM, CSFM		
Environmental	0°C - 49°C (32°F - 120°F) 93% RH, Non-condensing		
Frequency Response	400Hz to 4KHz @ +/- 3dB		
Output Voltage	25 VRMS or 70 VRMS		
THD (distortion)	< 7%		
Wire Size	18 to 12 AWG (1.0 to 2.5 mm²)		
Internal Tone Generator	1KHz Temporal (3-3-3) Tone (evacuation); 20 PPM (alert)		
SIGA-CC1/2 Support	10 Units, Maximum		
Standby Current	62mA for 20 and 40 watt amps; 64mA for the 3-ZA95 watt amp		
Alarm Current	1120mA	2480mA	5540mA
Pwr. Ltd. Audio Output Wiring Configuration EOL Resistor	Class A or B 15K Ohms in Class B	Class A or B 15K Ohms in Class B	Class A or B 15K Ohms in Class B
Pwr. Ltd. 24 Vdc NAC Wiring Configuration Line Resistance, Max.* EOL Resistor Line Capacitance, Max	Class A or B (Style Z or Y) 50 Ohms, Max. N/A 0.33µF	Class A or B (Style Z or Y) 50 Ohms, Max. N/A 0.33µF	N/A
Space Requirements	1 LRM Space		2 LRM Spaces

Maximum Speaker Circuit Distance at 0.5 dB loss*

70 VRMS Output	3-ZA20A	3-ZA40A	3-ZA95
#12 AWG (3.2 Ohm/1000 ft pair)	4,536 ft (1,382 m)	2,268 ft (691 m)	955 ft (290 m)
#14 AWG (5.2 Ohm/1000 ft pair)	2,792 ft (850 m)	1,396 ft (425 m)	588 ft (179 m)
#16 AWG (8.0 Ohm/1000 ft pair)	1,815 ft (553 m)	907 ft (276 m)	382 ft (116 m)
#18 AWG (13 Ohm/1000 ft pair)	1,117 ft (340 m)	558 ft (170 m)	235 ft (71 m)

25 VRMS Output	3-ZA20A	3-ZA40A	3-ZA95
#12 AWG (3.2 Ohm/1000 ft pair)	579 ft (176 m)	289 ft (88 m)	122 ft (37 m)
#14 AWG (5.2 Ohm/1000 ft pair)	356 ft (108 m)	178 ft (54 m)	75 ft (22 m)
#16 AWG (8.0 Ohm/1000 ft pair)	231 ft (70 m)	116 ft (35 m)	49 ft (14 m)
#18 AWG (13 Ohm/1000 ft pair)	142 ft (43 m)	71 ft (21 m)	Not supported by 18 AWG

* Refer to product manual for wire run calculations.

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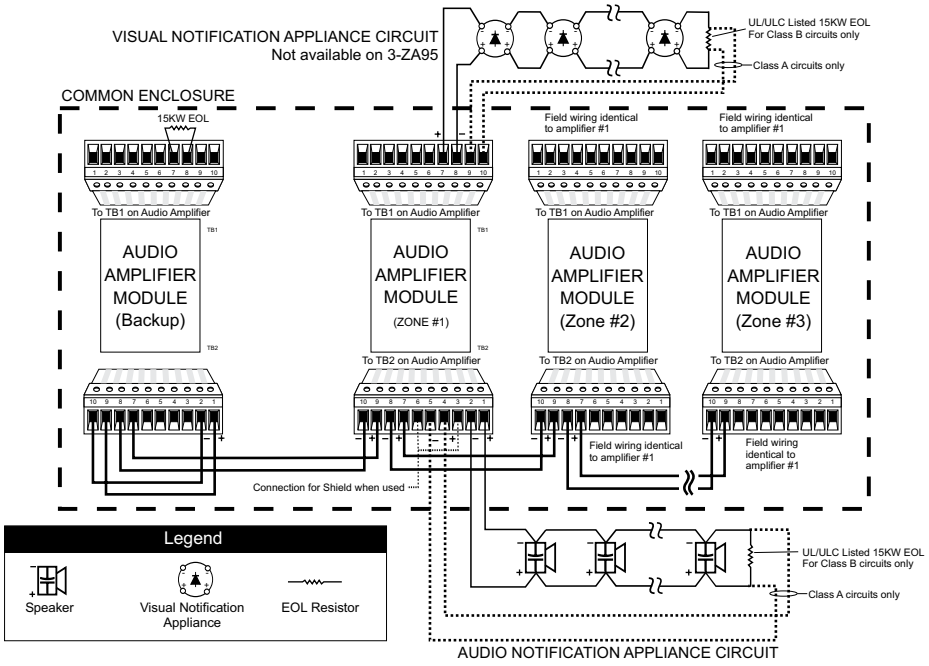
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Typical Wiring



Ordering Information

Model # (SKU)	Description	Shipping Weight
3-ZA20A	20 Watt Zoned Amplifier w/Class A/B (Style Z/Y) Audio & Class A/B (Style Z/Y) 24 VDC outputs. Add suffix "-E" for EN54 compliant versions.	1.55lb (0.7kg)
3-ZA40A	40 Watt Zoned Amplifier w/Class A/B (Style Z/Y) Audio & Class A/B (Style Z/Y) 24 VDC outputs. Add suffix "-E" for EN54 compliant versions.	1.55lb (0.7kg)
3-ZA95	95 Watt Zoned Amplifier w/Class A/B (Style Z/Y) Audio output	3.0lb (1.5kg)
4-FIL	Blank EST4 filler plate (order separately when no LED or LED/Switch module is installed on the inner door).	0.1lb (0.05kg)

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

EST4 Audio Units and Interfaces

4-MIC, 4-FT, 4-LCDAUDTEL



FM APPROVED | NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL | UL | ULC | CE EN54

Overview

Nothing connects with building occupants better than spoken words, and EST4's highly intelligible voice audio ensures that those words are heard loud and clear. This high-fidelity messaging, across EST4's impressive capacity of 200 channels, provides the flexibility needed to get messages out clearly and concisely.

EST4's voice audio function is built modularly from a collection of components finely tuned to the needs of small and large facilities alike. System designers can specify an ideal voice audio system by pinpointing the right components for the project, and selecting only equipment needed to get the job done. All audio components are standard modules that fit together easily. Each is an integrated part of EST4, allowing the use of the same cabinets, power supplies, and even network cabling as other EST4 components.

EST4 microphones and telephone handsets, along with their controllers, are used to create Notification Control Areas (NCAs) that can contain one or more Command Centers. EST4 allows both mass notification and emergency communications to be addressed, delivering live paging and pre-recorded messaging where its needed. EST4 supports configurations with Central Control Stations (CCSs), Autonomous Control Units (ACUs), and Local Operations Consoles (LOCs). Together, these options provide the opportunity to find an efficient yet economical Emergency Communications audio solution for any size installation.

Standard Features

- **Annunciator or Cabinet Mounting**
  One SKU for mounting in any cabinet configuration.
- **Paging Priority Automatically Set**
  Ensures highest priority paging location has control.
- **Color Touch-screen Audio Interface**
  LCD touch-screen interface for paging circuit selection.
- **Customizable Switch Modules, Multi-color LEDs**
  Tactile and visual feedback with printable slide-in labels.
- **200 Audio Channels per Network**
  100 Channels per Notification Control Area (NCA). Eight channels for audio source selection.
- **Use Twisted Copper Wires or Fiber Optic Cables for Audio**
  Network data, audio and firefighter telephone are transmitted on the same cables, helping reduce installation cost and complexity.
- **Listed for Mass Notification**
  Listed to UL2572 as CCS or ACU or LOC.
- **Supports Low Frequency Signaling in Sleeping Areas**
- **Auxiliary inputs, telephone interface**
  Auxiliary inputs allow other audio systems to be interconnected
- **Digital Transmission of Audio Signals**
  Greater noise immunity, high quality signal transmission.
- **On-Board Storage of Programmed Messages and Tones**
  Distributed storage helps overcome a single point of failure.
- **Optional LCD Display of Fire Phone Calls**
- **Optional Earthquake Hardening**
  OSHPD seismic pre-approval for Component Importance Factor 1.5.

Application

EST4 integrated audio is a modular group of components that install in standard fire alarm cabinet assemblies. The Audio Command Center, which holds audio control equipment, provides an emergency user interface for live and recorded paging, and optionally, a firefighters' master telephone or microphone. Zoned amplifiers mount in the main control panel or in remote cabinets, allowing distribution of the system, reducing the need to home run speaker wiring. Remote cabinets are easy to install because only a single twisted pair is required between cabinets, carrying not only audio, but network data and firefighters' telephone audio as well.

EST4 goes beyond standard emergency systems, ensuring that audio can provide the resources needed to cover the applications of even the largest and complex life safety applications. EST4 supports connection of local and network microphones, multiple telephone voice lines, and Mass Notification audio. It also expands the potential of these capabilities with 200 audio voice channels – an industry first. In fact, up to 100 audio channels per NCA support any combination of eight channels at the panel. These 100 channels for Paging, Alert, Evacuation signalling and automatic messages are delivered simultaneously to the parts of a building or buildings that need the information.

Efficient deployment

EST4 supports high fidelity digital audio, providing intelligibility that is not compromised at any point in the system. A dramatically simplified interconnect architecture handles up to 100 audio channels per NCA, and audio data can be transmitted over the same inter-panel cabling as other EST4 data. This means that paging, firefighters' telephone, and panel data can all share the same cable – significantly reducing project material expenses and installation labor costs for new installations and allowing audio to be added to many retrofit applications without the need of additional cables.

EST4 audio applications benefit from the inherent reliability and performance of zoned amplifiers, along with simplified user interface options, network interconnection flexibility, and several layers of survivability. All this combines to provide a flexible, cost-effective, and reliable audio solution.

Effective Control

The 4-LCDAUDTEL LCD module provides a dedicated color touchscreen user interface option for selecting page circuits, and placing and receiving calls over the Firefighter Telephone Handset. The LCD module mounts to the inner door of cabinets or annunciators.

LED-Switch Modules may be used exclusively for audio control, or used in conjunction with the LCD user interface. These modules offer convenient slide-in strips for custom and color-coded labeling. Switch modules provide both tactile and visual feedback when a switch selection is made, offering instant verification that the command has been received by the system.

The 4-MIC Microphone assembly works with LED-Switch modules and the LCD touch-screen user interface. It also comes standard with a VU volume level that shows the signal level provided by the microphone during the page process.

Survivable Distributed Audio

EST4's true distributed audio ensures the survivability of emergency messaging functions even in the face of catastrophic events. All pre-recorded messages are stored at the control panel, and programmed audio channel selection is made locally as well. This means that programmed messages will become active when a locally generated alarm is initiated — even if a network failure has occurred. Zoned amplifiers also have integrated 1000 Hz temporal tone generators that will produce a backup signal should the control panel CPU go offline. For additional system redundancy, a single standby amplifier can back up any zoned amplifier installed in the same cabinet.

Network wiring can also be configured in several ways to bolster the survivability of live paging and event notification throughout the network. These layers of redundancy provide audio system survivability that keeps life safety measures in place. There is no need to rely on network data transmissions of pre-recorded messaging. The panel always plays the message for events based on the event. This ensures fast selection and reliable playback even under the harshest conditions.

Uncomplicated Plug-and-Play Configuration

Adding a microphone or firefighters' telephone at any EST4 control panel is as easy as plugging in a module. The 4-AUDTELS and 4-ANNAUDTEL interface modules mount to the back of the 4-CPU main processor unit or to a 4-ANNCPU annunciator CPU. The interface modules accept connections from locally-mounted microphones or telephones. Pre-recorded messages are stored at each panel that have zone amplifiers so there is no need to have a microphone or telephone at every panel. Nonetheless, EST4 does support multiple paging microphone masters and fire fighter telephone masters with programmable request-grant-deny function. This ensures that messaging is provided by those in control of the system.

Audio Components

4-AUDTELS Audio-Telephone Interface Module



The 4-AUDTELS enables and processes information from connected microphone or telephone units mounted directly to the right of the CPU. The 4-AUDTELS also provides audio input-output, and is the source for a telephone riser that supports remote handsets and up to four line-level balanced audio input/output connections are available. The four balanced audio connections can be individually programmed as inputs or outputs, each rated for 1 Vrms nominal signal level. Multiple 4-AUDTELS may be installed in an EST4 network, providing support for multiple telephone riser applications and multiple low-level audio inputs/ outputs.

4-ANNAUDTEL Annunciator, Audio, and Telephone Interface Module



The 4-ANNAUDTEL mounts to the top of the 4-ANNCPU. The 4-ANNAUDTEL enables and processes information from connected microphone or telephone units. The module mounts in remote annunciators as well as in lobby cabinets.

4-LCDAUDTEL LCD Display Module for Audio and Telephone Control



The optional 4-LCDAUDTEL LCD module provides a dedicated color touch-screen user interface for selecting page circuits and for placing and receiving calls over the Firefighters' Telephone Handset. The LCD module mounts to the inner door of cabinets or annunciators. The interface does not have common control push buttons. The 4-LCDAUDTEL touch screen LCD may be used as the only method of making audio and telephone selections, or it may be used in combination with LED-Switch modules. For a complete list of LCD options please see the Ordering Information table.

4-MIC - Paging Microphone



The 4-MIC paging microphone mounts to the inner door of cabinets and annunciators, taking only two spaces. The 4-MIC is easy to use. It provides a hand-held microphone with push-to-talk switch and a multi-color amber-green-red volume meter on the assembly. The 4-MIC can be used for general alarm paging. Where no zoning is needed, simply pick up the mic, press the push-to-talk switch, and make the page to the entire system. Use an LED-Switch Module or 4-LCDAUDTEL color touch-screen interface where zoning or specific messaging operations are needed.

4-FT - Firefighter Master Handset



The 4-FT firefighter master handset mounts to the inner door of cabinets and annunciators, taking only two spaces. The 4-FT is used in conjunction with the 4-AUDTELS or 4-ANNAUDTEL interface modules. The 4-AUDTELS provides a firefighter telephone riser connection for remote warden stations. Telephone call-in selection may be annunciated at the control center via standard EST4 LED-Switch modules or the 4-LCDAUDTEL color touch-screen. Where multiple command centers are deployed, EST4 easily configures for request-grant-deny operation, ensuring that one command center is in control at one time, but allowing for changes in control if required.

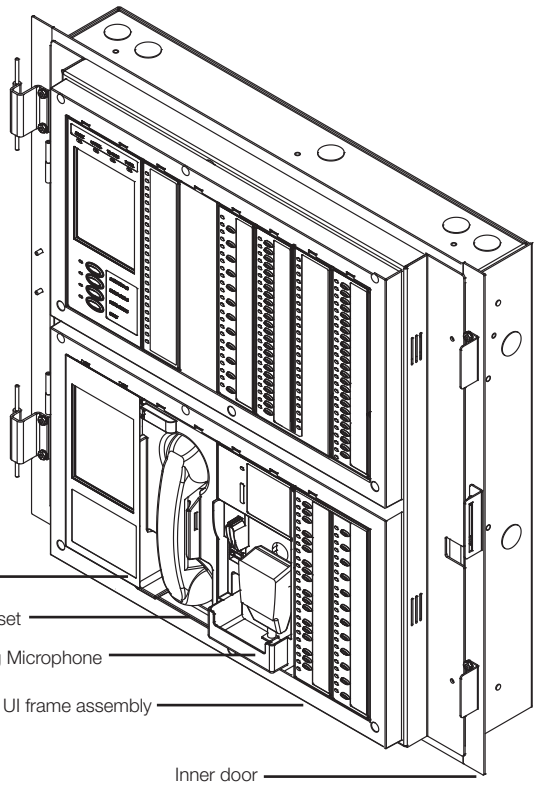
Assembly

The 4-LCDAUDTEL, 4-FT, and 4-MIC modules each occupy two slots on the UI frame assembly.

To install the audio units, insert the tabs at the bottom of the module into the slots at the bottom of the UI frame assembly. Push the top of the module toward the UI frame assembly until the two locking tabs at the top of it lock into place on the UI frame assembly.

For a more secure installation, install two 4-40 x 7/16 screws from the back side of the UI frame assembly into the standoffs on the back side of the module.

Note: The 4-FT installs on the UI frame assembly shown in slots 3 and 4, when mounting the 4-FT above a 3-CHAS chassis assembly, the two spaces directly behind the 4-FT on the chassis must not contain other equipment.



Engineering Specification

Provide emergency audio as part of the main fire alarm control panel. The emergency audio shall contain a paging microphone, pre-recorded messages <fire fighter telephone> and zoned amplifiers capable of delivering multi-channel audio messages. The system shall support a minimum of 100 audio channels. Transmission of audio shall be over the same data network wiring as the fire panel data. The network shall be over a dedicated <single copper pair> <dual multimode fibers>, <dual Single mode fibers><one single mode fiber> to remote parts of the facility.

For systems requiring multiple locations for paging, the ability to Request/Grant/Deny page privileges shall be supported. Priorities shall be configured in software covering projects operational priorities between Autonomous Control Units (ACU), Central Control Station (CCS) and Local Operators Consoles (LOCs).

Each panel shall store digitally up to 750 minutes of pre-recorded audio messages as WAV files without the need to add additional memory storage devices. These messages shall be automatically played in various areas of a facility under program control. The system shall have the capacity to store up to 200 individual audio messages. Each audio channel shall support up to 200 individual messages. Each panel shall simultaneously play back any of seven (7) different message channels in addition to a live page message of the 100 available.

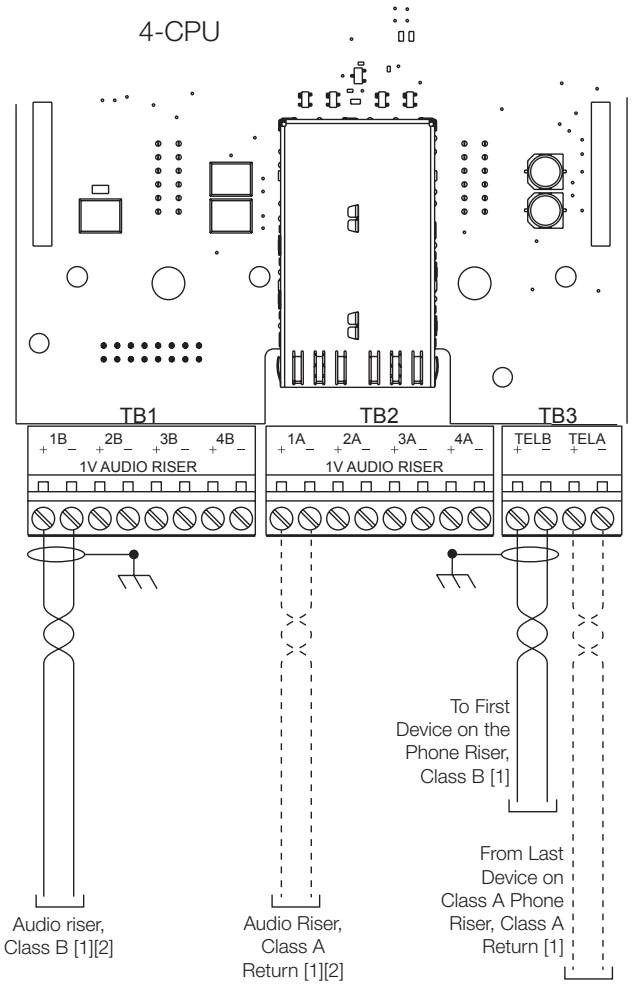
The system must provide operation to 25Vrms or 70.7Vrms speakers. The system must provide as a minimum the following paging common controls and indicators: Ready to page LED, three color VU display shows signal level provided by the microphone, single switch function for paging to all — Alert zones, Evacuation zones, and areas not programmed for signaling. The system must provide high quality analog to digital conversion of paging sources. Digital transmission of paging must be provided between system nodes over the same cabling as other system data. The analog sources must be sampled and converted to digital across the network.

System amplifiers must be distributed zoned type. Centrally banked systems are not acceptable. The circuit must carry a minimum rating of 3.5 Amps for operating 24 Vdc signals.

The system shall provide fully integrated fire fighters' telephone system that shall provide two-way communication between the fire alarm control panel and any firefighters' telephone station. << Audio and Firefighters' Telephone shall be installed so that a seismic component Importance Factor of 1.5 is achieved.>> <<The system shall include a dedicated color LCD touch screen user display and controls. When a telephone is activated, a call-in buzzer shall sound, and the location of the phone shall be shown on the LCD display. The display shall be capable of bilingual operation, displaying English, French, Spanish, or Portuguese messages.

All incoming calls and all connected phones shall be selected by touching the LCD screen. All subsequent telephone call locations shall be displayed in full text. The system shall display all incoming calls, all connected phone(s) on the color LCD display. The system shall be configured so that page messages may be issued from any firefighter's telephone connected to the system, as directed by the emergency operator.

Wiring, 4-AUDTELS



[1] For Class B risers, install a 15 kΩ EOLR at the last device on the riser. Do not install an end-of-line resistor if the riser is wired Class A.

[2] Audio riser connections can be programmed as inputs or outputs using the 4-CU configuration utility.

Technical Specifications

4-LCDAUDTEL Audio and Firefighter Telephone Control Display

Current	Connected to 4-ANNCPU
Active	93mA
Standby	40mA @ 20% brightness
Display	18 bit color. 640 x 480 pixels, resistive touch screen
Agency Approvals	UL, ULC, FM, CSFM and NYC Fire Dept.
Operating environment	Temperature: 32 to 120°F (0 to 49°C) Relative Humidity:0 to 93% noncondensing

4-MIC Paging Microphone

Current	
Active	38mA
Standby	8mA
Common controls/ indicators	
VU meter	Represents the signal level from the microphone input
Ready To Page	Flashes during preannouncement tone, steady when ready to page
Agency Approvals	UL, ULC, FM, CSFM, CE and NYC Fire Dept.
Operating environment	Temperature: 32 to 120°F (0 to 49°C) Relative Humidity:0 to 93% noncondensing

4-FT Firefighter Telephone Master Handset

Current	Connected to 4-ANNCPU
Active	168mA
Standby	9mA
Optional telephone riser	See 4-AUDTELS specifications.
Agency Approvals	UL, ULC, FM, CSFM and NYC Fire Dept.
Operating environment	Temperature: 32 to 120°F (0 to 49°C) Relative Humidity:0 to 93% noncondensing

4-AUDTELS Audio and Telephone Interface/Riser Module

Current	
Standby	85 mA at 24 VDC
Alarm/active	101 mA at 24 VDC
Ground fault impedance	5k Ω
Wire size	22 to 12 AWG (0.5 to 2.5 mm²)

Telephone Riser specification	
EOL resistor	15k Ω (P/N EOL-15)
Active telephones	Five plus the master headset or six without the master handset
Wire type	Twisted pair, shielded
Configuration	Class A or Class B
Line impedance	52 Ω, 0.2 µF, max.

Audio Riser Specification	
EOL Resistor Class B	15KΩ (P/N EOL-15)
Wire type	Twisted pair, shielded
Voltage	1VRMS
Audio inputs/outputs	Up to four, configurable using the 4-CU
Operating environment	Temperature: 32 to 120°F (0 to 49°C) Relative Humidity:0 to 93% noncondensing
Agency Approvals	UL, ULC, FM, CSFM and NYC Fire Dept.

4-ANNAUDTEL Annunciator, Audio, and Telephone Interface Module

Current	
Standby/active	98mA @ 24VDC
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Humidity	0 to 93% noncondensing
Agency Approvals	UL, ULC, FM, CSFM and NYC Fire Dept.

LIFE SAFETY & INCIDENT MANAGEMENT

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Ordering Information

Model # (SKU)	Description	Shipping Weight
4-MIC	Paging Microphone	1.2lb (0.54kg)
4-MIC-E	Paging Microphone for EN54 applications	1.2lb (0.54kg)
4-FT	Firefighter Master Handset (See Note 1)	1.4lb (0.63kg)
4-LCDAUDTELANN	Display, LCD Module with Cable for Audio/Telephone Control annunciators in 4-8ANNMT, 4-16ANNMT and 4-24ANNMT enclosures	1.8lb (0.82kg)
4-LCDAUDTELCAB-CB	Display, LCD Module with Cable for Audio/Telephone Control with 4-BRKT-CB bracket. Supports mounting in 3-CAB7B, 3-CAB14B and 3-CAB21B series cabinets	2.9lb (1.32kg)
4-LCDAUDTELCAB-MPLT	Display, LCD Module with Cable for Audio/ Telephone Control with 4-MPLT mounting plate for 3-CAB7B, 3-CAB14B. 3-CAB21B, 4-16ANNMT and 4-24ANNMT	6.3lb (2.9kg)
Accessories and related equipment		
4-AUDTELS	Audio and Telephone Interface/Riser Module	0.7lb (0.29kg)
4-AUDTELS-E	Audio and Telephone Interface/Riser Module for EN54 applications	0.7lb (0.29kg)
4-ANNAUDTEL	Annunciator, Audio and Telephone Interface Module	0.3lb (0.13kg)
4-LCDAUDTEL	Display, LCD Module for Audio/Telephone Control	1.2lb (0.52kg)

Note 1: When mounting a 4-FT in a CAB series enclosure space directly behind the telephone must be left open for proper mounting.

Note 2: Unless otherwise specified, all SKUs may be used in EN54/UL/ULC applications.

EDWARDS

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EST4 Cabinets and Chassis

4-CAB Series, 3-CAB Series 3-RCC series, BC-1



4-CAB Series shown with optional equipment.

Overview

EST4 has a wide selection of cabinet arrangements allowing the greatest use of EST4's flexible modular design.

Cabinets support more interfaces and display modules than earlier systems, which means smaller or fewer cabinets need to be installed to provide the same display capacity. Cabinets also support optional mounting of Signature Series modules, which is another way to reduce the use of external cabinets.

Lobby enclosure wallboxes and doors are made from sturdy 14-gauge rolled steel. Wallboxes have a black baked enamel finish. Lobby enclosure doors feature a modern contoured door design and integral viewing windows. They come with metallic bronze (Pantone Coated PMS# P 171-16 C, Pantone RGB# 81 75 67, and RAL Classic/RAL Design# 7022) or red baked enamel finishes. The door designs and colors ensure that there is a match to system annunciators and battery cabinets for a consistent look throughout the facility.

Doors may be mounted as remote annunciators without the need to have large CAB enclosures behind. This allows larger equipment to be mounted remotely, minimizing wall penetrations in lobbies and public spaces, and removing the need to home-run all field wiring.

The EST4 lobby enclosures backboxes, doors and chassis units are ordered and shipped separately for easy staging on project sites. With a variety of sizes available, customized installations offer the flexibility to support up to two color LCD touch screens, and LED and switch modules offering configurations of 576 five color LED indicators, as well as 576 control switches along with microphone and firefighters' telephone options.

Standard Features

- **Left or Right-hand Hinging Doors**
  Allows the mounting of two cabinets side-by-side with full access while both doors are open.
- **Lag and Keyway Holes**
  Makes mounting of enclosures quicker and easier.
- **Attractive Contour Door Design**
  Lobby enclosures, annunciators, with their contour door designs, feature color-matched black wallboxes that complement distinctive metallic bronze doors.
- **Combination Flush or Surface Mounting Lobby Enclosure**
  Quicker installation with semi-flush trim built-in.
- **RCC Series House up to 65 Amp Hour Batteries**
  Remote Closet Cabinets support larger battery sizes reducing the number of boxes required.
- **Maximum Space for optional Control Display Modules**
  Inner doors not only support the user interface layer, but also acts as a deadfront so field wiring remains protected during system operation.
- **Optional Earthquake Hardening**
  OSHPD Seismic Pre-Approval For Component Importance Factor 1.5
- **Knockouts for 3/4-inch Conduit**
- **BC Series Support up to 40 AH Batteries**

Application

Lobby Enclosures

EST4 lobby enclosures provide space for control, monitoring and display modules where they remain visible even with the door closed and secure. Ideal for mounting in lobbies where appearance is important, doors will mount for right or left hand opening. Lobby enclosures come in several sizes to match individual project requirements.

The **3-CAB5B** mounts semi-flush or surface. A built-in rail assembly provides space for up to five local rail modules, no chassis assembly needed. Back space for 1-1/2 footprints provides room for a power supply, a 1/2 footprint module, and 10 AH batteries. The local rail module spaces provide room for amplifiers, SLC, and other modules. The 4-CAB8D or 4-CAB8DR door mounts to the 3-CAB5B providing eight spaces for user interface modules.

The **3-CAB7B** mounts semi-flush or surface, and with the contoured front door, 4-CAB16D(R) provides 16 spaces for common control and annunciation modules. Space is provided for two 17 AH batteries and one chassis assembly providing seven local rail module spaces. The door may be mounted with hinges on the left or on the right.

The **3-CAB14B** mounts semi-flush or surface, and with the contoured front door, 4-CAB24D(R) provides 24 spaces for common control and annunciation modules. Space is provided in the cabinet for two 17 AH batteries and two chassis assemblies providing 14 local rail module spaces. The door may be mounted with hinges on the left or on the right.

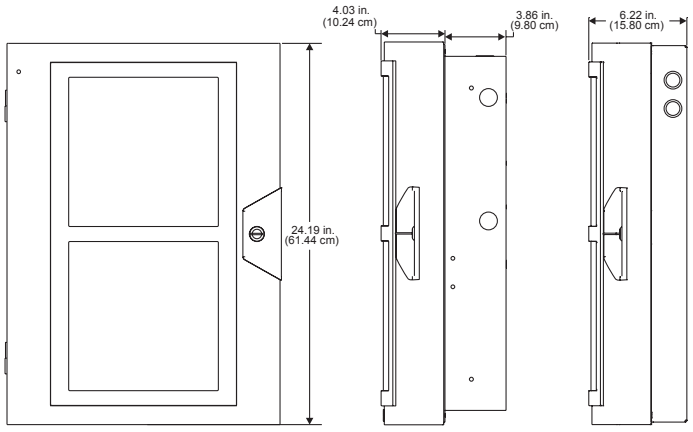
The **3-CAB21B** mounts semi-flush or surface, and with the contoured front door, 4-CAB24D(R)L provides 24 spaces for common control and annunciation modules. Space is provided for two 17 AH batteries and three chassis assemblies for 21 local rail module spaces. The door may be mounted with hinges on the left or on the right.

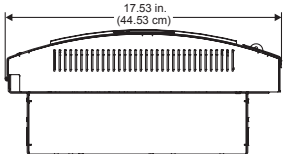
Remote Closet Cabinets

Remote Closet Cabinets provide an efficient way of installing equipment in locations such as electrical closets. An optional color LCD display module for system diagnostics can be mounted behind the front door. The LCD display module will not be visible with the door closed. Remote closet cabinets are surface-mounting and come in sizes providing space for one to three chassis with room for standby batteries. The Remote Closet Cabinets designs allow them to be used as remote battery cabinets and their red door and black wallbox match exactly the red and black of lobby cabinets for a clean finished installation.

Installation and Mounting, 4-CAB Door Assemblies

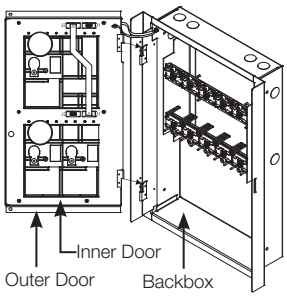
4-CAB8D Series Door Assembly

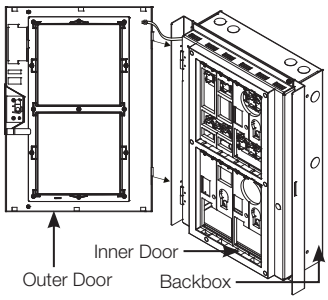




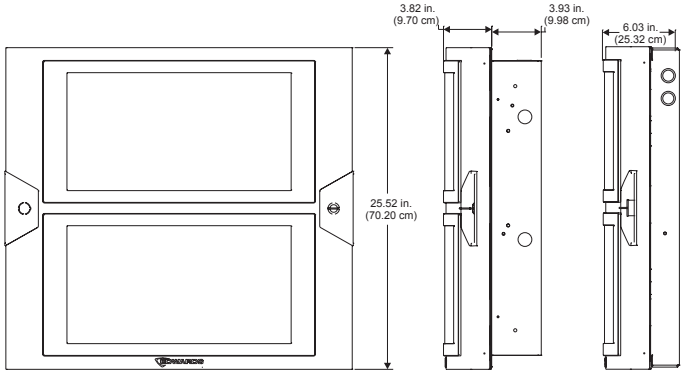
4-CAB8D installed on a 3-CAB5B backbox. Can be surface mounted or semiflush mounted.

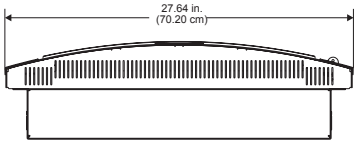
(2) 4-CAB8D installed on a 4-8ANNMT backbox. Can be surface mounted only





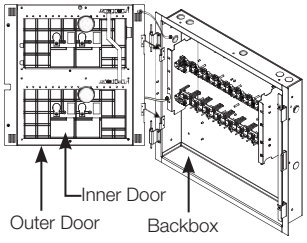
4-CAB16D Series Door Assembly

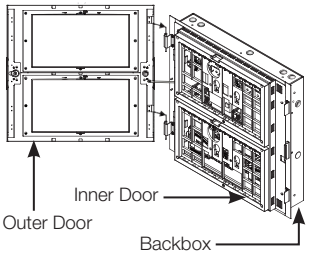




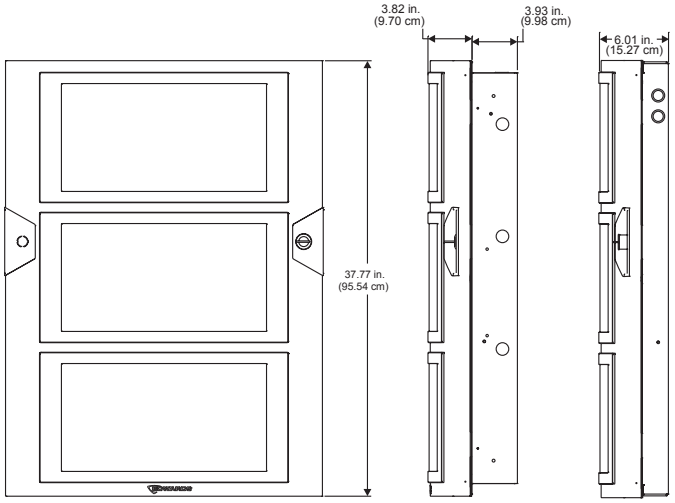
4-CAB16D installed on a 3-CAB7B backbox. Can be surface mounted or semiflush mounted.

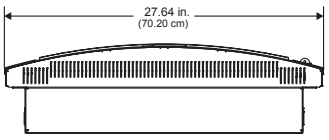
4-CAB16D installed on a 4-16AN-NMT backbox. Can be surface mounted only.





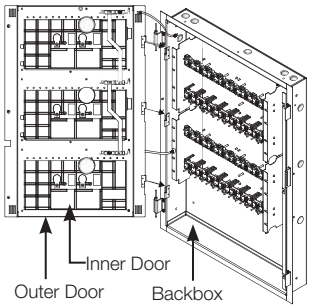
4-CAB24D Series Door Assembly

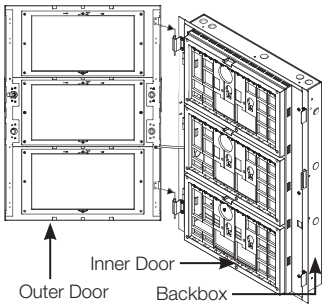




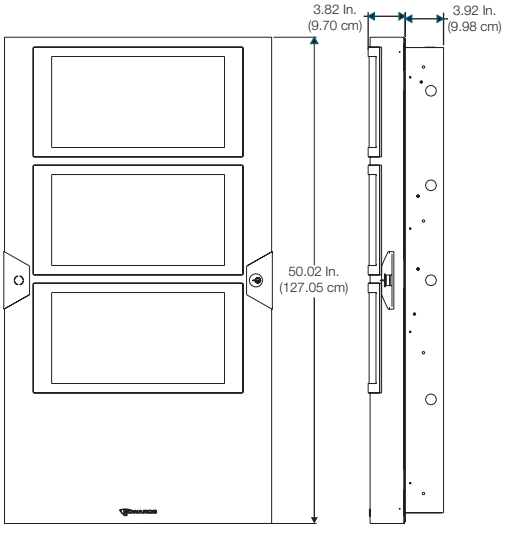
4-CAB24D installed on a 3-CAB14B backbox. Can be surface mounted or semiflush mounted.

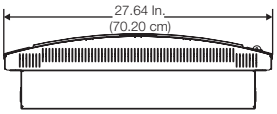
4-CAB24D installed on a 4-24ANNMT backbox. Can be surface mounted only.





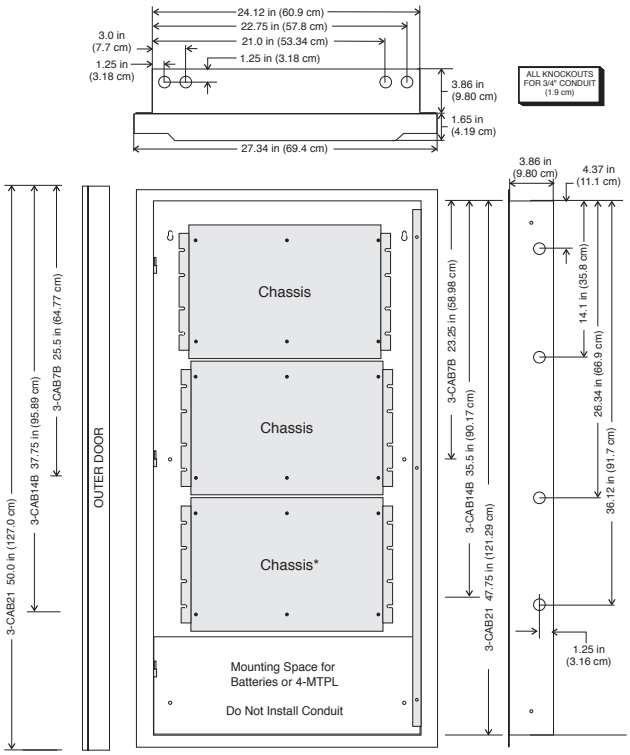
4-CAB24DL Dimensions





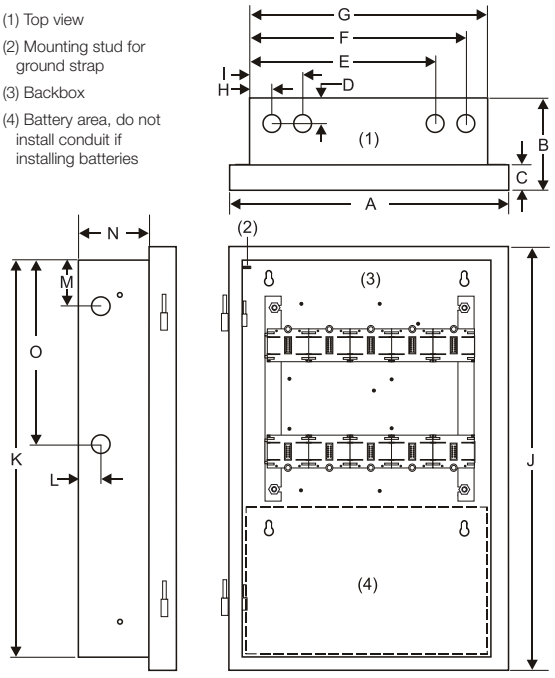
3-CAB Lobby Enclosures

3-CAB7B, 3-CAB14B, 3-CAB21B Lobby Enclosures



3-CAB5B Lobby Enclosure

(1) Top view
(2) Mounting stud for ground strap
(3) Backbox
(4) Battery area, do not install conduit if installing batteries



A	16.4 in (41.66 cm)	**F**	12.70 in. (32.26 cm)	**K**	22.37 in. (56.82 cm)
B	3.86 in (9.80 cm)	**G**	14.00 in. (35.56 cm)	**L**	1.11 in. (2.82 cm)
C	1.65 in. (4.19 cm)	**H**	1.30 in. (3.30 cm)	**M**	2.6 in. (6.6 cm)
D	1.34 in. (3.40 cm)	**I**	3.1 in. (7.87 cm)	**N**	3.86 in. (9.80 cm)
E	10.90 in. (27.69 cm)	**J**	23.87 in. (60.63 cm)	**O**	10.4 in. (26.42 cm)

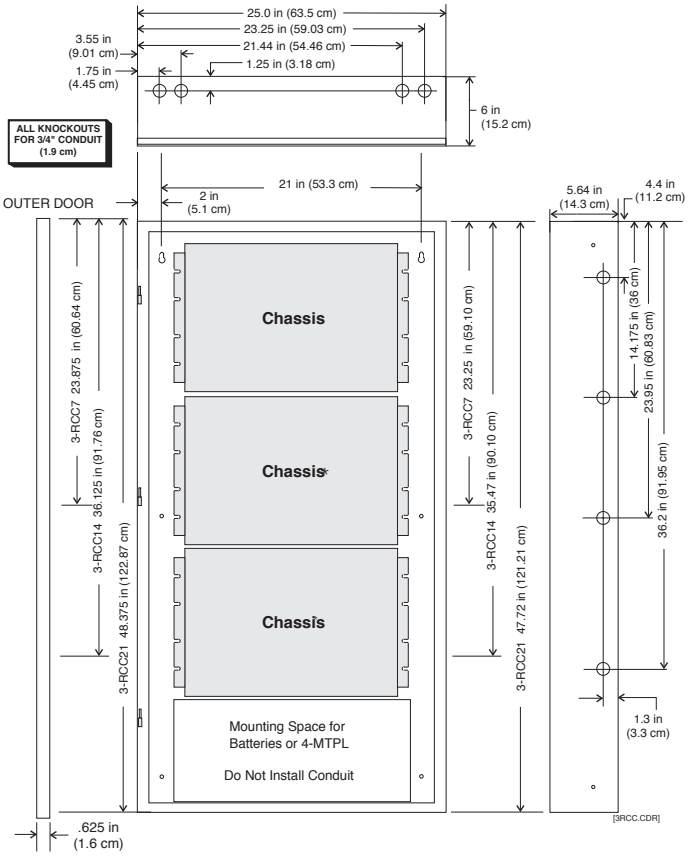
3-RCC Remote Closet Cabinets

Surface Mounted Remote Closet Cabinets
3-RCC7R, 3-RCC14R, 3-RCC21R



3-RCC Remote Closet Cabinet

The EST4 remote closet cabinet design allows the installation of control panel electronics in electrical closets. The remote closet cabinets have left-hand hinged doors and are available with red door finish and black wallbox only. Optional color display for system diagnostics can mount behind the closet cabinet door and is not visible with the door closed.

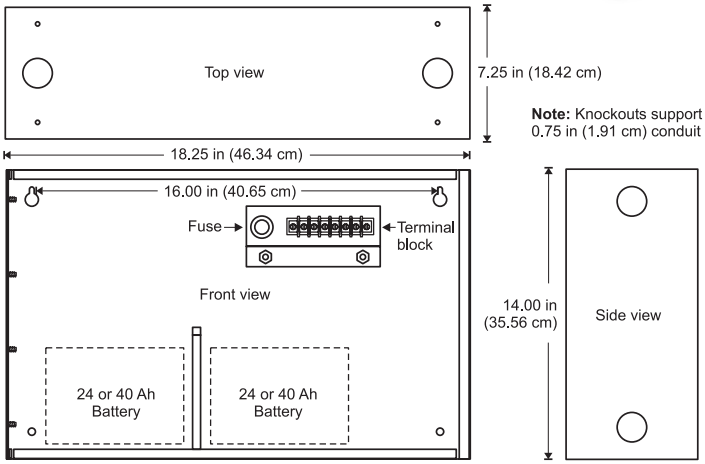


* The lower mounting space can be used for an MN-BRKT1 bracket, which holds MNEC interface equipment including an MN-NETSW1 Ethernet network switch, an MN-ABPM Audio bridge, an MN-FVPN VoIP module, and an MN-COM1S Communications module.

BC-1 Battery Cabinet

BC-1 Battery Cabinet





Ordering Information

Model # (SKU)	Description	Shipping Weight
Backboxes		
3-CAB5B	Backbox, black. Supports five Local Rail Modules. Not approved for EN54 applications.	20.0lb (9.07kg)
3-CAB7B	Backbox, black. Supports seven Local Rail Modules. Comes with space for one 3-CHAS7 and room for up to two 17 AH batteries. When batteries are mounted remotely, battery space may be used for 4-MPLT for mounting of optional equipment.	29.5lb (13.4kg)
3-CAB14B	Backbox, black. Supports 14 Local Rail Modules. Comes with space for one or two 3-CHAS7s and room for up to two 17 AH batteries. When batteries are mounted remotely, battery space may be used for 4-MPLT allowing mounting of optional equipment.	40.8lb (18.5kg)
3-CAB21B	Backbox, black. Supports 21 Local Rail Modules. Comes with space for one, two or three 3-CHAS7s and room for up to two 17AH batteries. When batteries are mounted remotely, battery space may be used for 4-MPLT allowing mounting of optional equipment.	51.3lb (23.3kg)
Door Assemblies, Eight User Interface Spaces (mount to 3-CAB5B backbox)		
4-CAB8D	Door Assembly – Metallic bronze outer door and black inner door with 8 user interface spaces, mounts to 3-CAB5B wallbox. Not approved for EN54 applications.	23.0lb (10.43kg)
4-CAB8DR	Door Assembly – Red outer door and black inner door with 8 user interface spaces, mounts to 3-CAB5B wallbox. Not approved for EN54 applications.	23.0lb (10.43kg)
Door Assemblies, 16 User Interface Spaces (mount to 3-CAB7B backbox)		
4-CAB16D	Door Assembly – Metallic bronze, comes with 16 User Interface spaces, mounts to 3-CAB7B wallbox.	36.0lb (16.33kg)
4-CAB16D-E	Door Assembly – Metallic bronze, comes with 16 User Interface spaces, mounts to 3-CAB7B wallbox. For EN54 applications.	36.0lb (16.33kg)
4-CAB16DR	Door Assembly – Red, comes with 16 User Interface spaces, mounts to 3-CAB7B wallbox.	36.0lb (16.33kg)
4-CAB16DR-E	Door Assembly – Red, comes with 16 User Interface spaces, mounts to 3-CAB7B wallbox. For EN54 applications.	36.0lb (16.33kg)
Door Assemblies, 24 User Interface Spaces (mount to 3-CAB14B backbox)		
4-CAB24D	Door Assembly – Metallic bronze outer door and black inner door with 24 user interface spaces, mounts to 3-CAB14B wallbox.	51.0lb (23.13kg)
4-CAB24D-E	Door Assembly – Metallic bronze outer door and black inner door with 24 user interface spaces, mounts to 3-CAB14B wallbox. For EN54 applications.	51.0lb (23.13kg)
4-CAB24DR	Door Assembly – Red outer door and black inner door with 24 user interface spaces, mounts to 3-CAB14B wallbox.	51.0lb (23.13kg)
4-CAB24DR-E	Door Assembly – Red outer door and black inner door with 24 user interface spaces, mounts to 3-CAB14B wallbox. For EN54 applications.	51.0lb (23.13kg)
Door Assemblies, 24 User Interface Spaces (mounts to 3-CAB21B backbox)		
4-CAB24DL	Door Assembly – Metallic bronze outer door and black inner door with 24 user interface spaces, mounts to 3-CAB21B wallbox.	65.0lb (29.48kg)
4-CAB24DL-E	Door Assembly – Metallic bronze outer door and black inner door with 24 user interface spaces, mounts to 3-CAB21B wallbox. For EN54 applications.	65.0lb (29.48kg)
4-CAB24DRL	Door Assembly – Red outer door and black inner door with 24 user interface spaces, mounts to 3-CAB21B wallbox.	65.0lb (29.48kg)
4-CAB24DRL-E	Door Assembly – Red outer door and black inner door with 24 user interface spaces, mounts to 3-CAB21B wallbox. For EN54 applications.	65.0lb (29.48kg)
Equipment Wallboxes		
3-RCC7R	Cabinet with Red door and Black wallbox. Supports up to one 3-CHAS7 and Two - 12V10A or Two - 12V17A, or Two - 12V50A. When batteries are mounted remotely, battery space may be used for 4-MPLT allowing mounting other optional equipment.	45.9lb (22.6kg)
3-RCC14R	Cabinet with Red door and Black wallbox. Supports up to two 3-CHAS7 and Two - 12V10A or Two - 12V17A, or Two - 12V50A or Two - 12V65 (See note 1). When batteries are mounted remotely, battery space may be used for 4-MPLT allowing mounting other optional equipment.	62.1lb (28.2kg)
3-RCC21R	Cabinet with Red door and Black wallbox. Supports up to three 3-CHAS7 and Four - 6V8A, or Two - 12V10A, or Two - 12V17A, or Two - 12V50A, or Two - 12V65 (See note 1). When batteries are mounted remotely, battery space may be used for 4-MPLT allowing mounting other optional equipment.	79.0lb (35.8kg)
Battery Cabinets		
BC-1	Battery Cabinet – Black back box, Metallic bronze door. Supports up to 40AH batteries	19.8lb (9kg)
BC-1R	Battery Cabinet – Black backbox, red door. Supports up to 40AH batteries.	19.8lb (9kg)

Note 1: Remote closet cabinets will support 65 AH batteries with the use of the 3-BATS Battery Shelf, which reduces the enclosure's chassis capacity by one chassis.

EDWARDS

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Accessories and Related Equipment

Model # (SKU)	Description	Shipping Weight
4-LOCK2KEY	Replacement door lock and two keys	1.0lb (0.45kg)
4-HNG714	Replacement Hinge Assembly CAB7 or 14	1.5lb (0.68kg)
4-HNG21	Replacement Hinge Assembly CAB21	2.0lb (0.91kg)
3-CHAS7	Takes one chassis space in wallbox, provides space for seven local rail modules, up to two power supplies, and a 1/2 footprint module.	9.4lb (4.2kg)
3-CHAS7-I	Takes one chassis space in wallbox, provides space for seven local rail modules, up to two power supplies, and a 1/2 footprint module. For EN54 applications.	9.4lb (4.2kg)
4-MPLT	Mounting Plate mounts in chassis space or in the battery space of cabinets in place of batteries.	4.3lb (1.95kg)
4-BRKT-CB	Mounting Bracket provides space for mounting any one of 4-ANNCPU, 4-FWAL-1, 4-FWAL-2, 4-FWAL-3, 4-FWAL-4, or a 4-NET-AD module. Mounts on the back plane of a 3-CHAS7.	1.1lb (0.5kg)
4-BRKT-CS	Mounting Bracket provides space for mounting any one of 4-FWAL-1, 4-FWAL-2, 4-FWAL-3, 4-FWAL-4, or a 4-NET-AD module. The bracket mounts to the side of a 3-CHAS7.	1.2lb (0.54kg)
3-BTSEN	Battery sensor/distribution module.	2.0lb (0.9kg)
3-BTSEN-E	Remote battery cabinet interlace, temperature sensing. For EN54 applications.	1.0lb. (0.45kg)
3-BATS	Battery Shelf for RCC Enclosures. Takes one chassis space. Room for up to one 65 AH or two 50 AH batteries.	3.9lb (1.8kg)
BC-1EQ	BC-1 - Seismic Battery hold down for BC-1. Supports up to two 40 Ahr batteries. Order BC-1 Separately.	2.1lb (1kg)
3-CABEQ	3-CAB - Seismic Battery hold-down for 3-CAB 7, 14 or 21. Supports two 1 2V batteries from 10 Ah up to 18 AH. Comes with EST3 Chassis hardening hardware and instructions. Order 3-CAB7, 3-CAB14 or 3-CAB21 separately. See Note 1.	2.5lb (1.1kg)
3-RCCEQ50	3-RCC series - Seismic Battery hold-down. Supports one set of two 50 Ah batteries. Comes with EST3 Chassis hardening hardware and instructions. Order 3-RCCxxR separately. See Note 1.	1.6lb (0.7kg)
3-RCCEQ65	3-RCC series cabinet - Seismic Battery hold-down. Supports one set of two 65 Ah batteries (one battery in bottom of cabinet, one battery mounted on 3-BATS). Order 3-RCCxxR cabinet and 3-BATS separately. See Note 1.	4.3lb (2kg)
4-TAMP	Tamper switch for 3-CAB7B, 3-CAB14B and 3-CAB21B cabinets with 4-CABXXD series doors. Mounts to side of cabinet.	0.45lb (0.2kg)
3-TAMPRCC	3-TAMPRCC Tamper Switch for RCC series cabinets. Mounts to side of cabinet.	0.5lb (0.2kg)
3-TAMP5	Tamper switch for 3-CAB5B. Mounts to side of cabinet.	0.3lb (0.1kg)
4-CABLUSBLG	Long USB 3.0 Cable w/ A and B connector Types	0.3lb (0.14kg)

The above enclosures and doors are fully listed to UL-864 and ULC-S527 standards.

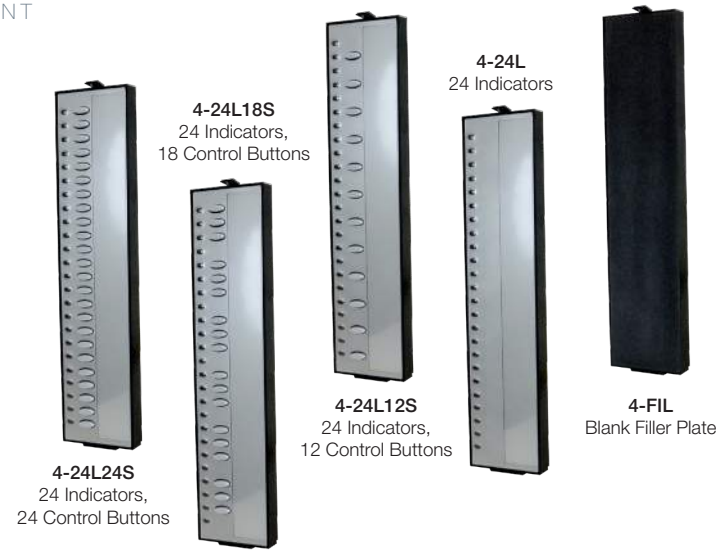
Note 1: For earthquake anchorage, including detailed mounting weights and center of gravity detail, please refer to the Seismic Application Guide. Approval of panel anchorage to site structure may require local AHJ, structural, or civil engineer review.

Note 2: Unless otherwise specified, all SKUs may be used in EN54/UL/ULC applications.

LIFE SAFETY & INCIDENT MANAGEMENT

EST4 Control Display Modules

4-24L Series



FM APPROVED | NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL | UL | ULC | CE | EN54

Overview

EST4 Control-Display Modules provide first responders and emergency users with easy-to-operate controls and at-a-glance indication when time is of the essence and event information is critical.

Control-Display Modules come with 24 LED indicators and are available with 0, 12, 18, or 24 control buttons. LED indicators are actually comprised of five individual LEDs, each of a different color. Programmers configure indicators to display their pre-selected color according to the type of information conveyed by the indicator. This offers a level of design efficiency that can reduce the number of display strips necessary for an application. In addition to color selection, the flash rate of the LED may be programmed to provide even more information. Examples include: damper and fan status, or audio zone notification status, alert, evaluation or paging.

Control display modules simply snap into place on the inner door of control panels or annunciators, and can mount in any unused display location. They can be positioned according to use, and spaced to create a physical separation between different control functions.

Control modules feature large and easy-to-see buttons. They provide tactile feedback when pressed, and visual feedback by means of the associated indicator, which flashes briefly when the button is activated.

Printable slide-in label inserts give control-display modules context with color-coded shading and other effects. They can be localized for regional language requirements, and printed on-the-fly to accommodate system changes as they are implemented.

Up to 576 tactile switches and 576 indicators may be mounted in a single EST4 cabinet. Module lamp test can be programmed to any spare control switch, or by selecting the Lamp Test feature from the LCD display.

Standard Features

- **Modules Mount on Inner Door of Cabinet**
  Simple snap-in modules speed installation, provides a clean look.
- **Rubber Buttons for Switch Control**
  Provides durability with great tactile feedback of switch operation.
- **Selectable LED Colors**
  Minimizes the inventory needed to support operations.
- **Slide-in Customizable Labeling**
  Print color-coded and regional languages from the Configuration Utility.
- **Stable Frame Assembly**
  Ensures positive switch operation.
- **Switch Radio Groups**
  Allows up to 24 switches in a group.
- **Synchronized Indicator Flash Rates Across Network**
  Consistent indication between nodes.
- **Visual Feedback of Switch Activation**
  Visual feedback of a switch press by status LED color change.

Application

Life Safety Systems require only occasional operation. Yet, in an emergency the user must be able to identify system operation and status quickly and without hesitation. LCD screen displays are excellent for identifying specific information, but even a large LCD display cannot convey overall system status as effectively as individual LEDs and switches.

Simple design, sophisticated operation

EST4 control-display modules are designed to provide simple identification and operation of system functions for the emergency user. They offer positive feedback of control activity with flexibility for selection of display configurations and mounting location options. This configuration flexibility means that there are fewer models needed to cover a wide array of applications. In fact, just four models handle all the control and display options needed for EST4 operation.

At each indicator location, display modules have five individual LEDs: red, yellow, blue, green and white. At configuration time the system designer matches the color of the LED to the needs of the system design. This allows maximum use of indicator and switch locations on each module, making it unnecessary to skip or leave indicator spaces blank because the color is wrong for the application.

Multi-use modules increase efficiency

Flexible multi-use design allows the same control-display model to be used for several different applications. For example, the 24-indicator 4-24L may be used for displaying zone annunciation, or zone annunciation with disable indicator, or zone annunciation with trouble, or a combination of all three.

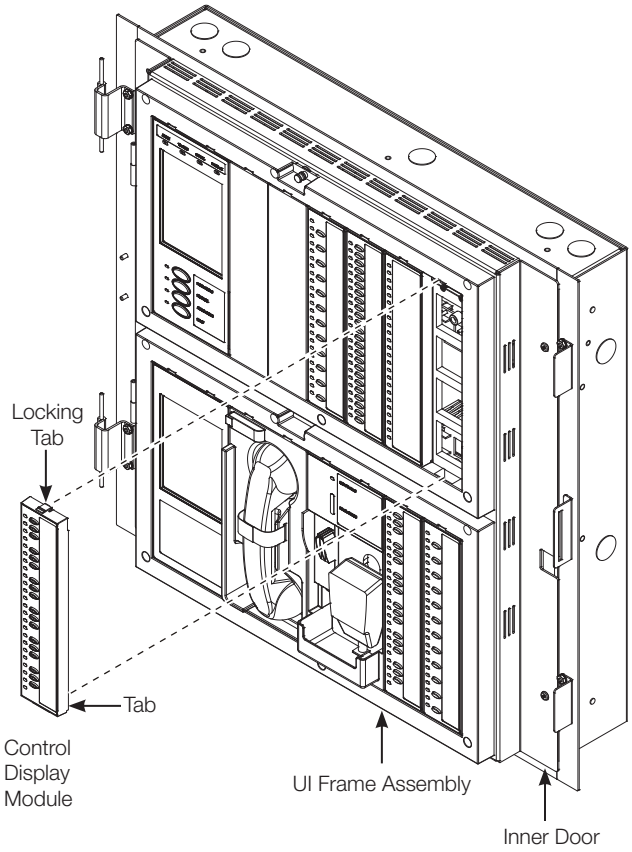
Switches can also work independently, or they can be grouped into a latching-interlock to support operations that must be kept separated, such as fan and damper control. The interlock is controlled by software, so only one switch is active at a given time. EST4 offers further flexibility by supporting the interlock of not just two or three switches in a group, but the interlock of any combination – right up to the full module complement of 24 switches.

Radio switch groups are also an option with EST4 control modules, as are On-Off-Auto configurations, and a variety of HVAC and building control system operations. In fact, the EST4 command and control interface is much more than the sum of its constituent parts, and its design flexibility is sure to inspire new and creative ways to make buildings safer.

Engineering Specification

The Life Safety system shall incorporate annunciation of Alarm, Supervisory, Trouble and Monitor operations. Annunciation must be through the use of LED display strips, complete with a means to custom label each LED/Switch position as to its function. The labels must support the ability to allow visual custom grouping of LEDs and switches. Where applicable, control of remote smoke control devices must be made available at the control center. Switches with LEDs must provide positive feedback to the operator of remote equipment status. All individual indicator LEDs shall be configurable for color including Red, Yellow, Blue, Green or White to facilitate identification from a distance and maximize display location usage. Where voice audio is required, a means of paging individual zones must be available. The status of each paging zone must be annunciated. It must be possible to selectively page into specific zones. It shall be possible to manipulate the evacuation of the building from the main control center. It must be possible for the emergency operator to put specific zones into evacuation manually. When being serviced or when it is necessary to disable switches, the system shall not ‘remember’ if a disabled switch is pressed. Switches’ must be rubber to provide tactile feedback as well as a visual indication when a switch is activated.

Installation



Technical Specifications

	4-24L	4-24L12S	4-24L18S	4-24L24S
Indicators	24	24	24	24
Switches	0	12	18	24
Current Standby Alarm	 4.0 mA at 24 VDC 10.0 mA at 24 VDC			
Mounting	Display modules mount on the inner door of the following door assemblies: 4-CAB8D, 4-CAB16D, 4-CAB24D, 4-CAB24DL, 4-4ANND, and 4-6ANND			
Operating environment	Temperature: 32 to 120°F (0 to 49°C). Relative humidity: 0 to 93% noncondensing.			
Agency Listings	UL, ULC, FM, CSFM, CE and NYC Fire Dept.			

Agency approvals: UL864 10th edition - UOJZ, UUKL, SYZV, UOQY, UL2017 2nd edition - FSZI, UL2572 2nd edition - PGWM; ULC-S527-11 3rd edition - UOJZ, UULK7, SYXV7, ULC-S576-14 1st edition - PGWM7, ULCS-S559-13 2nd edition - DYR7

Note 1: Unless otherwise specified, all SKUs may be used in EN54/UL/ULC applications.

Ordering Information

Model # (SKU)	Description	Shipping Weight
4-24L	24 Indicator Display Module	0.6lb (0.27kg)
4-24L-E	24 Indicator Display Module, EN54 compliant model	0.6lb (0.27kg)
4-24L12S	24 Indicator 12 Control Display Module	0.65lb (0.29kg)
4-24L12S-E	24 Indicator 12 Control Display Module, EN54 compliant model	0.65lb (0.29kg)
4-24L18S	24 Indicator 18 Control Display Module	0.65lb (0.29kg)
4-24L18S-E	24 Indicator 18 Control Display Module, EN54 compliant model	0.65lb (0.29kg)
4-24L24S	24 Indicator 24 Control Display Module	0.65lb (0.29kg)
4-24L24S-E	24 Indicator 24 Control Display Module, EN54 compliant model	0.65lb (0.29kg)
4-FIL	Blank Filler Plate	0.1lb (0.04kg)

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

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EDWARDS
Built for Resilience

EST4 Signature Driver Controller Modules

4-SSDC, 4-SDDC, 4-SDC



Approvals
EST4

NYC Fire Dept.
2025-TMCOAP-005355-AMND

7165-1657:
0186/0306

S3000

Overview

The 4-SSDC and 4-SDDC Signature Driver Controller modules provide an intelligent interface between the CPU module and Signature Series devices. Each module contains its own microcontroller used to coordinate, process and interpret information received from and sent to Signature devices. Power and communications are received directly from the control panel rail assembly. The 4-SSDC Signature Single Driver Controller module supports one Signature Data circuit, while the 4-SDDC Signature Dual Driver Controller module supports two Signature circuits. Both modules occupy one rail space in the fire alarm control cabinet and provide removable field wiring terminals to aid installation.

Innovative design gives the 4-SSDC/4-SDDC and Signature devices truly “distributed intelligence”. Signature detectors and modules have their own on-board microprocessor communicating with the loop controller in a fully digital communication format. This increases the accuracy of the information coming to and from the loop controller by reducing the effects of capacitance and noise.

With decentralized intelligence much of the decision-making moves from the loop controller to the devices. Advanced fire detection algorithms processed within the Signature devices effectively end unwanted alarms. Environmental compensation and multiple sensing element decision making operations are resident in the devices. Intelligent devices allow the Signature Controllers to execute communication and system functions with greater speed and low baud rates, increasing the accuracy of information transmitted between the loop controller and devices.

Standard Features

- One or two circuit versions
- Dedicated microcontroller
- Full digital communication
- Specialized communication protocol
  – Less sensitive to cable characteristics
  – Utilize existing wiring in most applications
- Device location supervision
  – Unexpected additional device addresses
  – Missing device addresses
  – Switched device locations
  – Programmed device parameters
- Automatic nonvolatile as-built mapping
  – Stores “actual” and “expected” device data
  – Stores physical connection sequence including “T” taps
- Automatic day/night sensitivity
- Supports up to 125 intelligent Signature detectors and 125 – Intelligent Signature Modules
- Up to five 4-SDDCs or ten 4-SSDCs per node
  – Maximum of 10 signature circuits per cabinet
- Removable field wiring terminal blocks
- Multiple survival modes – improved stand alone mode
- Supports the full line of current Signature devices, including carbon monoxide detection

Application

Up to 125 detectors and 125 modules are supported over a single pair of wires by the 4-SDC Signature Cards that plug into the Signature controller modules. Loop distances over 11,000 feet (3300m) are possible. Class B wiring, Class A and Class X (64 isolators max) wiring are supported.

The 4-SSDC and 4-SDDC use advanced communication formats that provide exceptional response. Using a “BROADCAST POLL” the loop controller checks the entire device circuit for any changes of state. Should one or more devices report a change the 4-SSDC/4-SDDC uses “DIRECT ADDRESS SEARCH” to find reporting device(s). Devices that have entered the alarm state or become active are located nearly instantaneously.

The unique use of “BROADCAST POLLING” combined with “DIRECT ADDRESS SEARCH” ensures that only new information is transmitted allowing a reduced baud rate with fast response time. The low baud rate is ideal for retrofit applications since in most applications existing wiring can be used.

To enhance survivability of the system the 4-SSDC/4-SDDC supports a standalone mode for Signature devices. Two catastrophic failure modes are supported. If the CPU fails, the loop controller will continue to poll its devices. If an alarm is detected it will be sent on the local rail communication bus and received by other local rail modules. A common alarm condition throughout the panel will result. If the local rail module (4-SSDC/4-SDDC) fails, and a device (smoke or module) detects an alarm, specialized circuitry will make the node aware of the alarm condition and output activators are limited to specific loop that failed. The CPU will communicate the alarm condition to the rest of the network. Having multiple redundant modes is paramount in a life safety system.

Every time the 4-SSDC/4-SDDC communicates with a detector a green LED on the detector flashes. Normal green LED activity is not disturbing to building occupants but can be quickly spotted by a maintenance technician. A red LED on the detector turns on only in the alarm condition.

The 4-SSDC/4-SDDC also supervises the device wiring, physical location of each device and the programmed device characteristics. This EDWARDS/Signature Series unique characteristic is accomplished by “MAPPING” the Signature circuit and committing the map to memory. Upon power up the loop controller will scan device serial numbers and map their physical location sequence on the loop, including “T” taps. After mapping is complete the controller automatically addresses each detector and module through downloading over the loop. There are no switches or dials to set. Each device is assigned a unique soft address generated by the site-specific program.

The 4-SSDC/4-SDDC then compares the “Actual” physical device data to the “Expected” site specific program data. If any correlations are different, the loop controller issues a trouble to the CPU identifying the devices which do not match and posting a map fault. Through the CPU port a graphical map of the loop can be uploaded depicting each device’s location on the loop, including branches (T-Taps) and all of the physical attributes associated with the device. This diagnostic information is unparalleled in the fire detection industry and vital for keeping accurate records on how the system was installed.

During installation a common problem with analog/addressable systems is locating ground faults. The 4-SSDC and 4-SDDC controllers have the ability to locate ground faults by specific module, speeding up the troubleshooting process. Another significant advantage of the 4-SSDC/4-SDDC controllers during commissioning is electronic addressing and mapping. This eliminates duplicate addresses, which are also very difficult for most systems to locate.

During maintenance, should groups of detector heads be removed for service and returned into the wrong smoke detector base (location), the 4-SSDC/4-SDDC will automatically detect the problem. If the attributes of the switched devices are the same, the system will automatically download the correct soft addresses and algorithms to the devices (maintaining location supervision).

If the attributes are not the same the 4-SSDC/4-SDDC will send a map fault indication to the CPU and post a trouble indicating the specific devices in fault.

The 4-SSDC/4-SDDC also monitors the Signature Series devices for maintenance and trouble conditions. Each smoke detector contains intelligence to adjust with environmental changes. This expands the amount of time required between cleaning while maintaining a constant alarm threshold. As the detector begins to exhaust the environmental compensation, and reaches the 80% level, the 4-SSDC/4-SDDC will indicate a maintenance alert or dirty condition to the CPU and indicate the specific device requiring cleaning. If cleaning is not performed the detector will continue to operate until all of its environmental compensation is utilized. At this point the 4-SSDC/4-SDDC sends a dirty trouble indication to the CPU and posts a trouble condition.

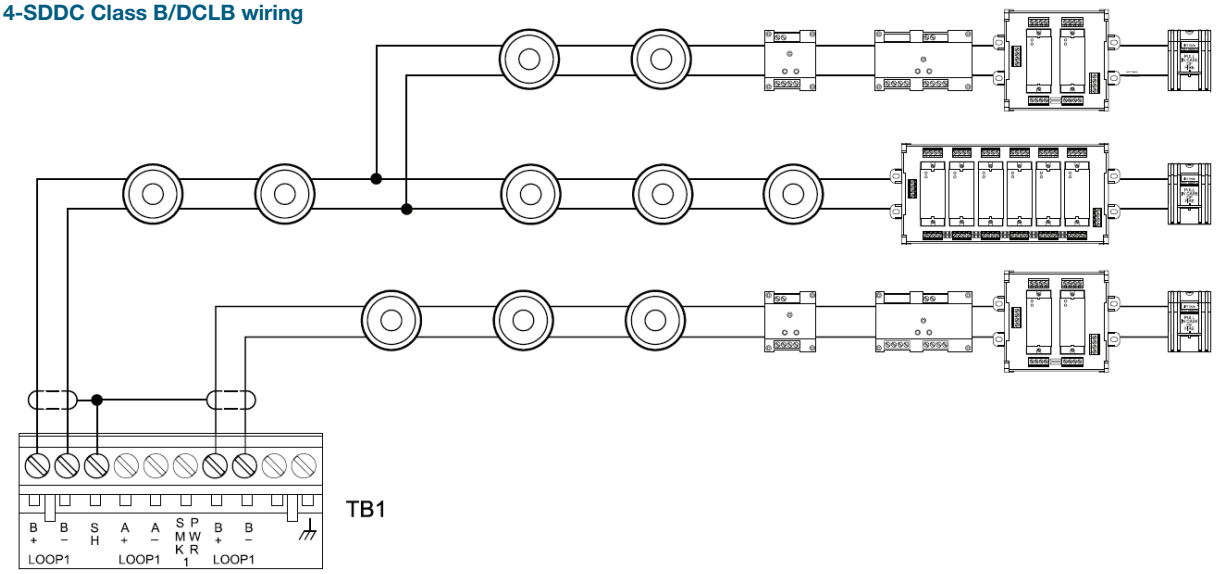
When a detector includes carbon monoxide (CO) detection, the detector monitors its CO life remaining for the CO sensor element and provides this information automatically to the panel. For maintenance of the system the CO life remaining is also available by simply running a maintenance report at the panel or through the FireWorks graphical interface. A unique CO maintenance signal is automatically generated by the panel approximately 6 months before the CO sensor reaches its end of life to allow for time to plan maintenance and replacement of the CO detector before it reports a CO sensor ‘End of Life’ trouble.

Remote test capability permits devices to be put in alarm, pre-alarm, supervisory, monitor, or security alarm, or trouble from the panel menu or controls. This facilitates testing of smoke and heat detectors as well as monitor and security devices. Fast test is also provided for CO detectors allowing these devices to be tested quickly in the field.

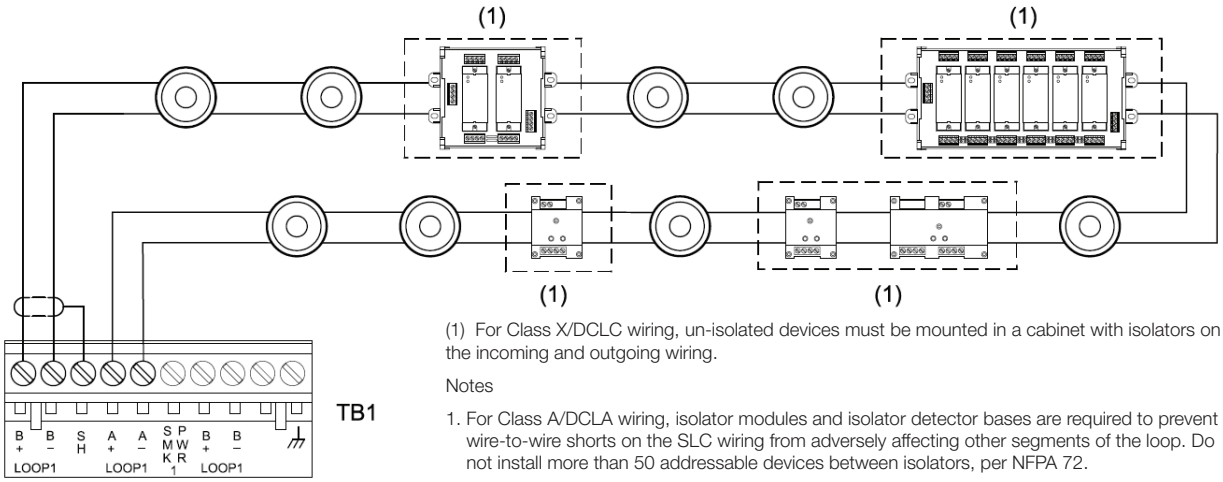
The 4-SSDC and 4-SDDC local rail modules are backwards compatible with the 3-SSDC, 3-SDDC, 3-SSDC1, and 3-SDDC1 respectively local rail modules. To upgrade a 3-SSDC1/3-SDDC1, 3-SSDC2/3-SDDC2 to a 4-SSDC/4-SDDC respectively, replace the 3-SSDCx/3-SDDCx Local Rail cards with a 4-SSDC/4-SDDC card.

Typical Wiring

4-SSDC and 4-SDDC Class B/DCLB wiring



4-SSDC and 4-SDDC Class A/DCLA[1] and Class X/DCLC[2] wiring

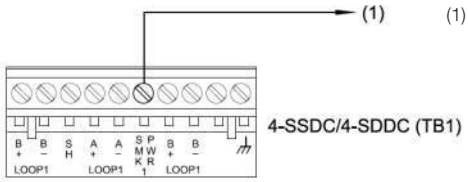


(1) For Class X/DCLC wiring, un-isolated devices must be mounted in a cabinet with isolators on the incoming and outgoing wiring.

Notes

1. For Class A/DCLA wiring, isolator modules and isolator detector bases are required to prevent wire-to-wire shorts on the SLC wiring from adversely affecting other segments of the loop. Do not install more than 50 addressable devices between isolators, per NFPA 72.
2. For Class X/DCLC wiring, isolator modules and isolator detector bases are required to prevent wire-to-wire shorts on the SLC wiring from adversely affecting any devices of the loop.

Smoke power wiring



(1) Smoke power to SIGA-UM or SIGA-MAB for two-wire smoke detector.

Engineering Specification

The communication format between the control panel and analog devices shall be 100% digital.

Loop alarm recognition must be within 750 milliseconds of a device going into the alarm state, with system response time no greater than 3 seconds. All devices shall support remote testing.

It must be possible to wire the circuit as Class B, Class A or Class X with non-shielded, non-twisted wire. It must be possible to wire branches (T-taps) with Class B wiring.

The driver controller must be manufactured in accordance with ISO 9001 standards.

The system must have tolerance to multiple failures. There must be a standalone mode of operation that will ensure the system is aware of alarms even if the local rail or main CPU fails.

Specifications (Signature Circuits)

Charts assume wire and devices are evenly distributed over length of circuit

Non-twisted, non shielded wire

Device type	# of Detectors	# of Module Addresses	#14 AWG (20pf/foot) (2.53 Ohm/1000ft)	#16 AWG (20pf/foot) (4.02 Ohm/1000ft)	#18 AWG (20pf/foot) (6.38 Ohm/1000ft)
Detectors only	125	0	14,752 feet (4,497 meters)	9,275 feet (2,827 meters)	5,839 feet (1,780 meters)
Modules only	0	125	12,599 feet (3,840 meters)	7,921 feet (2,414 meters)	4,986 feet (1,520 meters)
Detectors and Modules	125	125	5,738 feet (1,749 meters)	3,608 feet (1,100 meters)	2,271 feet (692 meters)
Detectors and Modules with 2-wire smokes	63	55 + 9 SIGA-UM	7,623 feet (2,324 meters)	4,793 feet (1,461 meters)	3,017 feet (920 meters)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	3,798 feet (1,158 meters)	2,388 feet (728 meters)	1,503 feet (458 meters)

Twisted pair non shielded wire

Device Type	# of Detectors	# of Module Addresses	#14 AWG (38pf/foot) (2.53 Ohm/1000ft)	1.5mm² (36pf/foot) (3.75 Ohm/1000ft)	#16 AWG (36pf/foot) (4.02 Ohm/1000ft)	1.0mm² (25pf/foot) (5.51 Ohm/1000ft)	#18 AWG (25pf/foot) (6.38 Ohm/1000ft)
Detectors only	125	0	13,157 feet (4,010 m)	9,933 feet (3,028 m)	9,275 feet (2,827 m)	6,760 feet (2,061 m)	5,839 feet (1,780 m)
Modules Only	0	125	12,599 feet (3,840 m)	8,483 feet (2,586 m)	7,921 feet (2,414 m)	5,774 feet (1,760 m)	4,986 feet (1,520 m)
Detectors & Modules	125	125	5,738 feet (1,749 m)	3,864 feet (1,178 m)	3,608 feet (1,100 m)	2,630 feet (802 m)	2,271 feet (692 m)
Detectors and modules with 2-wire smokes	63	55 + 9 SIGA-UM	7,623 feet (2,324 m)	5,133 feet (1,565 m)	4,793 feet (1,461 m)	3,494 feet (1,065 m)	3,017 feet (920 m)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	3,798 feet (1,158 m)	2,558 feet (780 m)	2,388 feet (728 m)	1,741 feet (531 m)	1,503 feet (458 m)

Twisted pair shielded wire

Device Type	# of Detectors	# of Module Addresses	#14 AWG (84pf/foot) (2.53 Ohm/1,000ft)	#16 AWG (82pf/foot) (4.02 Ohm/1,000ft)	#18 AWG (58pf/foot) (6.38 Ohm/1,000ft)
Detectors only	125	0	5,952 feet (1,814 meters)	6,098 feet (1,859 meters)	5,839 feet (1,780 meters)
Modules Only	0	125	5,952 feet (1,814 meters)	6,098 feet (1,859 meters)	4,986 feet (1,520 meters)
Detectors & Modules	125	125	5,738 feet (1,749 meters)	3,608 feet (1,100 meters)	2,271 feet (692 meters)
Detectors and modules with 2-wire smokes	63	55 + 9 SIGA-UM	5,952 feet (1,814 meters)	4,793 feet (1,461 meters)	3,017 feet (920 meters)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	2,558 feet (780 meters)	2,388 feet (728 meters)	1,503 feet (458 meters)

Note 1: For a complete list of compatible devices please refer to the EST4 Compatibility List (P/N 3102304).

Specifications (controllers)

Catalog Number	4-SSDC	4-SDDC
Installation	1 LRM Space	1 LRM Space
Module Configuration	1 Addressable circuit (4-SDC Card) expandable to 2 circuits.	2 Addressable circuits (4-SDC Cards)
Operating Current (see Note 2)	Standby 168 mA Alarm 198 mA	Standby 268 mA Alarm 309 mA
Operating Voltage	24 VDC, Nominal	
Address Requirements	Automatic	
Detectors Supported	125 per 4-SDC Card	
Modules Supported	125 Module Addresses per 4-SDC Card	
2-Wire Smoke Power Output	Voltage 24 VDC Standby current 46.5 mA max.[3] Alarm current 65.0 mA max.[4]	
Conventional detectors supported	Refer to the EST4 Compatibility List (P/N 3102304)	
Signature Circuit Voltage	21.0 V max.	
Maximum Signature Circuit Resistance	100 Ohms	
Maximum Signature Circuit Capacitance	0.5 µF	
Communications Format	100% Digital	
Circuit Wiring Styles	Class B, Class A or Class X (64 isolators max)	
Termination	Removable plug-in terminal strip(s) on module	
Permissible Wire Size	18 to 12 AWG (0.75 to 2.5 mm²)	
Agency Listings	UL, ULC (see Note 1)	
Operating Environment	32 °F (0 °C) to 120 °F (49 °C) 93% RH, non-condensing	

1. Excludes smoke power current.
2. 125 detectors in alarm; 125 modules activated.
3. Maximum 15 SIGA-UM/SIGA-MAB modules at 3.1 mA per module
4. The first SIGA-UM/SIGA-MAB entering alarm will consume 17 mA, all other SIGA-UMs/SIGA-MABs (up to 14) not in alarm will consume 3.1 mA each. Subsequent SIGA-UMs/SIGA-MABs (up to 14) entering alarm will register the alarm, and then turn off their smoke devices, consuming no additional smoke power current.

Note 1: Other EST4 components are modularly listed under the following standards: UL 864 categories: UOJZ, UUKL and SYZV, UL 609 category AOTX, UL 636 category ANET, UL 1076 category APOU, UL 365 category APAW, UL 1610 category AMCX, UL 1635 category AMCXULC-S527. Please refer to EST4 Installation and Service Manual for complete system requirements.

Note 2: Current shown Includes full loop of SIGA devices.

Ordering Information

Catalog Number	Description	Shipping Wt. lb (kg)
4-SSDC	Single Signature Driver Controller. Comes with one 4-SDC Device Card. Mounts to Local Rail.	0.5 (0.23)
4-SDDC	Dual Signature Driver Controller. Comes with two 4-SDCs. Mounts to Local Rail.	0.5 (0.23)
4-SDC[1]	Signature Device Card - upgrades a 4-SSDC to a 4-SDDC.	0.25 (0.11)
4-FIL	*Blank EST4 filler plate (order separately when no LED or LED/Switch module is installed on the inner door).* For use in UL/ULC markets.	0.1 (0.05)
3-FP	Filler Plate, order separately when no LED or LED/Switch module installed. For use in UL/ULC markets.	0.1 (0.05)

Note 1: The 4-SDC is not compatible with legacy 3-SXDC2 loop controllers.

Contact us

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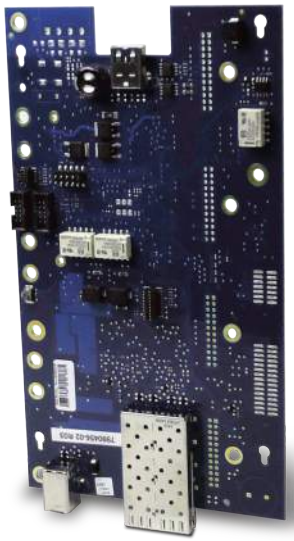
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LIFE SAFETY & INCIDENT MANAGEMENT

EST4 Network Firewalls

4-FWAL Series



NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL

EN54

Overview

The security and integrity of the EST4 network is paramount to its ability to maintain systems operations in the face of outside threats. The most vulnerable point of contact for any integrated building system is where it meets the facility owner's existing TCP/IP network. Ironically it is this gateway, which enhances and expands system capability beyond the communications network, that also exposes the system to some of its most critical vulnerabilities. 4-FWAL Series firewalls mitigate those vulnerabilities by providing a barrier between the EST4 life safety platform and the external connections necessary in today's networked building infrastructure.

4-FWAL firewalls communicate to other EST4 panel modules including the 4-CPU, 4-ANNCPU and 4-NET-AD. Each 4-FWAL firewall also has two small form-factor pluggable (SFP) slots that support its network adapters. These are used to connect to external networks, and provide physical layer options for connections between outside equipment and EST4 CAT or fiber cabling. 4-FWAL firewalls support both IPv4 and IPv6 networks, thus removing concern over network addressing compatibility.

EST4 firewalls are mounted inside the control panel. Panel power and communications is provided via a single internal USB cable. All firewalls provide engineered cybersecurity measures, including hashing of passwords, authentication, and encryption. The 4-FWAL series provides the interface between the fire system networking and the facility intra-net. EDWARDS recommends the installation of robust commercial firewall between the facilities intra-net and the Internet. To further enhance network security, an optional tamper switch may be installed on EST4 cabinet doors. This alerts the system when equipment enclosures accessed.

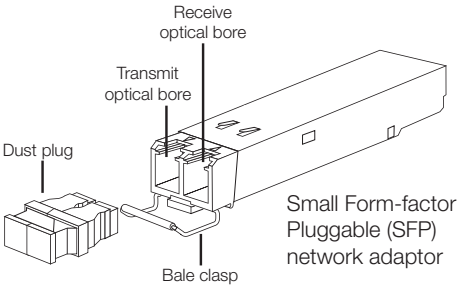
Standard Features

- **Secure Interface between EST4 and Outside Networks**
  Select the version of Firewall to support the features needed for the project from support for printers and Graphics through IP integration with central stations, web services, e-mail and secure connectivity to Edwards ConnectedSafety+ cloud services.
- **Multiple Physical Connection Options**
  Hot pluggable SFP-style network adapters allow selection of media including fiber and CAT cables.
- **Simple Interconnection with Panel Modules**
  Connection within the control panel is via USB cable.
- **Fully Listed as Part of the Fire System**
  End-to-end protection from external cyber threats.
- **Employs the latest Encryption Technology**
  Secure AES 256 algorithms per FIPS197 are used
- **IPv4 and IPv6 Support**
  Compatible with local network addressing methodology.

Application

4-FWAL firewalls make EST4 a safe and secure system for external connections. They meet Advanced Encryption Standard (AES), thus ensuring that the system is effectively insulated from malware that may exist on external networks. The EST4 proxy firewall uses Advanced Encryption Standard (AES) encryption and secure protocols making it FIPS Pub 197 certified. The FIPS, Federal Information Processing Standards, are the most current and most advanced encryption protocols administered by the National Institute of Standards and Technology (NIST).

All 4-FWAL Series firewalls provide the same high level of security and can be configured to meet the individual needs of the application. They come standard with one 3.0 Type A USB port and one 3.0 Type B USB port for connection to internal equipment, as well as two small form-factor pluggable (SFP) network adaptor connectors for connection to external networks.



Each 4-FWAL SFP slot supports connection directly to external equipment, or may connect to a switch in order to allow single point connection to multiple communications paths.

SFP adaptors are selected based on the physical layer needs of the facility infrastructure. Five versions are available, each for a different media type. They are hot swappable, so there is no need to power-down the system when changing out adaptors.

National and local codes and standards should be followed to ensure compliance with the options selected. Refer to the EST4 UL Listing Document P/N 3102302-EN for additional detail.

Engineering Specification

The systems shall support integrated Firewalls meeting the requirements of FIPS publication 197. It shall track relevant security information such as: failed login attempts, failed unauthorized accesses, and user modification shall be logged to panel history. Unsuccessful authentication attempts shall not leak information regarding the presence of the system or users. Credentials shall only be transmitted that are encrypted. The system shall provide for multiple users. Roles shall be provided for users to ensure proper access by user for the role they perform on the system. All passwords shall use a cypher algorithm for security purposes to protect any sensitive information. No passwords shall be visible as plain text within the database or entire system.

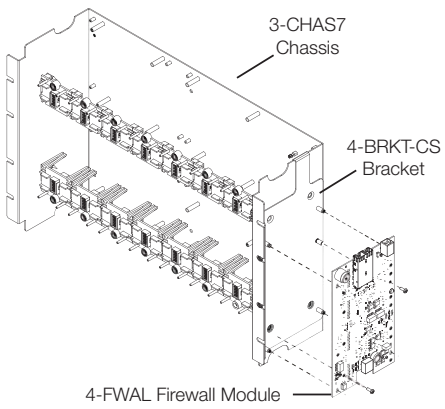
Sensitive information shall not be logged to history or displayed on service tools (e.g., passwords, PINs etc.).

The system shall support configuration of multiple IP connections to external services including, <central station>, <email servers>, <web interfaces>, <reports>, and <third party integration>. Email messages shall support multiple languages in native characters that match the languages supported in the panel. Email messages shall support symbolic and color alarm event high lighting.

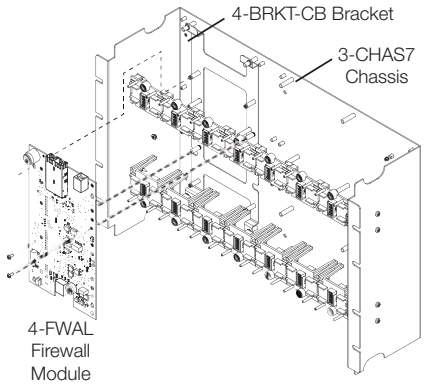
The system shall support connection to external services via <single-mode fiber>, <multimode fiber>, <CAT 5>. Connections to external systems shall be hot swappable removing the need to power down the life safety systems when deploying connections to external services. A minimum of eight external services shall be supported per Firewall. The system shall support installation of multiple Firewalls on the life safety network providing flexibility of connections to external services. A single point of connection into the system is not acceptable.

Mounting

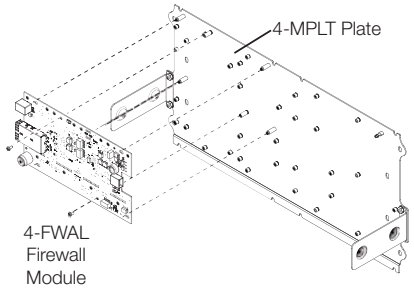
4-FWAL installation on 4-BRKT-CS



4-FWAL module installation on 4-BRKT-CB



4-FWAL module Installation on 4-MPLT



Firewall Selection Guide

Features	4-FWAL1	4-FWAL2	4-FWAL3	4-FWAL4
Eight concurrent services	✓	✓	✓	✓
FireWorks support	✓	✓	✓	✓
3rd party ECP-XML support	✓	✓	✓	✓
Supports downstream 4-USBHUB for printers and CDR-3 connections*	✓	✓	✓	✓
IP-DACT (dialer) support for Sur-Gard IP receivers		✓		✓
Web services (End user connection for standard reports)		✓	✓	✓
E-mail server connectivity			✓	✓
Edwards ConnectedSafety+ connectivity	✓	✓	✓	✓

*Does not use nor requires a Firewall CPU for serial printer support. Add suffix "-E" for EN54 compliant versions

Technical Specifications

SFP Cabling Specifications

SFP network adapter	Wavelength (nm)	Fiber type	Core size (microns) [1]	Modal bandwidth (Mhz/km) [2]	Cable distance Miles (km)
4-FWAL-MM [2]	1310	OM1/OM2	62.5um/50um	500	1.24 miles (2 km)
4-FWAL-SM	1310	G.652	9	N/A	6.2 miles (10 km)
4-FWAL-SMH	1310	G.652	9	N/A	24.8 miles (40 km)
4-FWAL-SMU	1310	G.652	9	N/A	6.2 miles (10 km)
4-FWAL-SMD	1550	G.652	9	N/A	6.2 miles (10 km)

[1] G.652, listed under core size for single mode fiber (SMF), refers to an ITU-T standard of commonly deployed non-dispersion-shifted single mode fiber with a core size of approximately 8 to 10 microns (µm).

[2] The maximum cable distance will be reduced when using fibers with less than 500 MHz/km bandwidth. For example, a 62.5u/125u step-index fiber may have a modal bandwidth as low as 160 MHz/km. This translates to a maximum 100Base link length of about 640 m. If 100u core fiber is installed, the length could be reduced to about 150 m.

SFP Optical Specifications

SFP network adapter	Transceiver type	Transmit power (dBm)		Receive power (dBm)		Max channel insertion loss in dB (by fiber type) [1]	Transmit and receive wavelength (nm)
		Min	Max	Min	Max		
4-FWAL-MM	100Base-FX	-20	-14	-31	-14	10 (62.5/125um OM1)	1300/1300
4-FWAL-MM	100Base-FX	-20	-14	-31	-14	5 (50/125um OM2)	1300/1300
4-FWAL-SM	100Base-LX10	-15	-8	-25	-8	5	1310/1310
4-FWAL-SMH [2]	100Base-LX40	-5	0	-33	-10	25 (10 dB min)	1310/1310
4-FWAL-SMU	100Base-BX10-U	-14	-8	-27	-8	5	1310/1550
4-FWAL-SMD	100Base-BX10-D	-14	-8	-27	-8	5	1550/1310

[1] Maximum channel insertion loss is defined for maximum distance guaranteed as specified in the Cabling Specifications table above and by fiber type/core diameter. When links are deployed over shorter distances, additional channel insertion loss may be allowed. Actual performance may allow greater insertion loss.

[2] 4-FWAL-SMH requires a minimum 10db insertions loss, if the insertion loss is less than 10db a single mode attenuator is required to obtain the minimum 10db loss.

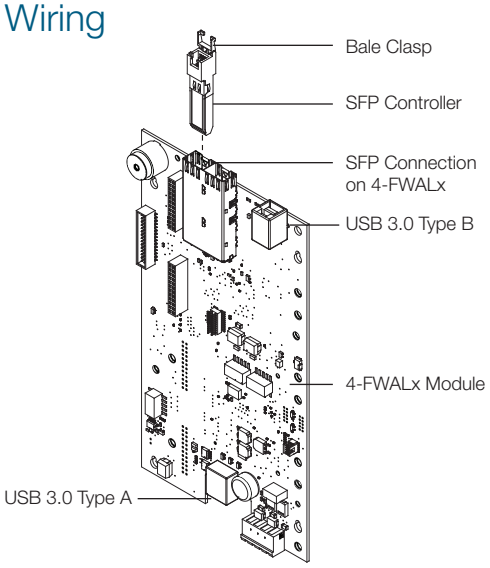
4-FWAL Specifications

Voltage	16 to 32 Vdc
Current: Standby	175 mA at 16 VDC 130 mA at 24 VDC 105 mA at 32 VDC
Alarm/Active	175 mA at 16 VDC 130 mA at 24 VDC 105 mA at 32 VDC
USB Ports	One Type A host (female port) requires use of V3.0 USB cable One Type B device (female port) requires use of V3.0 USB cable
Services	Up to 8 concurrent
Physical Connections	Two, max.
Agency	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept. [2]
Operating Environment	
Temperature	32 to 120 °F (0 to 49 °C)
Relative humidity	0 to 93% noncondensing

4-FWAL-CAT Specifications

Current	27 mA
Mounting	SFP slot in 4-FWAL series
Cable type	Cat 5e or better
Cable Connector	RJ-45
Distance	328 ft. (100m) max. between two interfaces
Agency	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept. [2]
Operating Environment	Temperature 32 to 120°F (0 to 49°C) Relative humidity 0 to 93% noncondensing

Wiring



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For inquiries regarding
Edwards Professional Services & Solutions,
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Ordering Information

Model # (SKU)	Description	Shipping Weight
4-FWAL1	Firewall – Provides secure connection to external systems. Supports up to eight concurrent IP connections. Provides support for connection to 4-USBHUB with printer and/or CDR3, SFP connection to FireWorks and other supported external connections.	1.0lb (0.43kg)
4-FWAL1-E	Firewall – Provides secure connection to external systems. Supports up to eight concurrent IP connections. Provides IoT Service for Edwards ConnectedSafety+. Provides support for connection to 4-USBHUB with printer and/or CDR3, SFP connection to FireWorks and other supported external connections. EN54 compliant model	1.0lb (0.43kg)
4-FWAL2	FireWall with DACT/Web support	1.0lb (0.43kg)
4-FWAL2-E	FireWall with DACT/Web support, EN54 compliant model	1.0lb (0.43kg)
4-FWAL3	FireWall with EMAIL/Web support	1.0lb (0.43kg)
4-FWAL3-E	FireWall with EMAIL/Web support, EN54 compliant model	1.0lb (0.43kg)
4-FWAL4	FireWall with DACT/EMAIL/Web support	1.0lb (0.43kg)
4-FWAL4-E	FireWall with DACT/EMAIL/Web support, EN54 compliant model	1.0lb (0.43kg)
Accessories and related equipment		
4-FWAL-MM	SFP Network Firewall Adapter, Multimode, Dual-Fiber, 100Base-FX 1310nm, for use in EN54/UL/ULC markets	0.25lb (0.11kg)
4-FWAL-SM	SFP Network Firewall Adapter, Single-Mode, Dual-Fiber, 100Base-LX10 1310nm, for use in EN54/UL/ULC markets	0.25lb (0.11kg)
4-FWAL-SMD	SFP Network Firewall Adapter, Single-Mode, Single-Fiber, Downlink, 100Base-BX10-D 1550nm/1310nm Tx/Rx, works with 4-FWAL-SMU, for use in EN54/UL/ULC markets	0.248lb (0.11kg)
4-FWAL-SMU	SFP Network Firewall Adapter, Single-Mode, Single-Fiber, Uplink, 100Base-BX10-U 1310nm/1550nm Tx/Rx works with 4-FWAL-SMD, for use in EN54/UL/ULC markets	0.25lb (0.11kg)
4-FWAL-SMH	SFP Network Firewall Adapter, Single-Mode, Dual-Fiber, 100Base-High Output 1310nm, for use in EN54/UL/ULC markets	0.25lb (0.11kg)
4-FWAL-CAT	SFP Network Firewall Adapter, CAT5 UTP Copper, 100Base-TX, 100Mbps, for use in EN54/UL/ULC markets	0.2lb (0.09kg)
4-MPLT	Mounting Plate, mounts in a chassis or battery space, for use in EN54/UL/ULC markets	4.3lb (1.95kg)
4-BRKT-CB	Mounting bracket for 4-FWAL series, allows mounting to the back of a 3-CHAS7, for use in EN54/UL/ULC markets	1.1lb (0.49kg)
4-BRKT-CS	Mounting bracket for 4-FWAL series, allows mounting to the right side of a 3-CHAS7, for use in EN54/UL/ULC markets	1.2lb (0.54kg)
4-CABLUSBLG	Cable, USB 3.0 A-B, Male, Long, for use in EN54/UL/ULC markets	0.3lb (0.14kg)
4-NET-XT	Network Extender Module – Mounts to DIN rail on 4-MPLT ordered separately, for use in UL/ULC markets only	0.75lb (0.34kg)

LIFE SAFETY & INCIDENT MANAGEMENT

EST4 Network Controllers

4-NET Series



FM APPROVED | NYC FIRE DEPT. COA # 2022-TMCOAP-008086-RENL | UL | ULC | CE | EN54

Overview

4-NET Series controllers are a series of small form factor pluggable (SFP) transceivers that provide physical media options for EST4 network cabling. The selection of the controller determines the media type. Eight models are available, each one offers a different kind of physical connection.

EST4 network controllers are easy to install and provide flexible solutions for system changes and upgrades. They mount into any EST4 panel on the life safety network by simply plugging into either of the two slots found on the 4-CPU, 4-ANNCPU, 4-CPUGRPH and 4-NET-AD modules. The controllers are hot-swappable and may be used in any combination of fiber, copper or CAT 5e or better cable.

Controllers allow vast distances between panels and thousands of addressable points. For example, a single IPv6 network can support up to an astonishing 375,000 addressable devices. Copper wire runs of nearly a mile between nodes puts detection, alarm, notification, and audio into the furthest reaches of the tallest buildings and broadest campuses.

EST4 gives the flexibility to configure the network to the needs of the installation, including no network redundancy (Class B), a single redundant connection (Class A/X), or any combination of styles including multiple redundant paths.

EST4 network controllers are used for panel-to-panel communications only. Connections to external networks are handled by 4-FWAL Series adapters. See the relevant literature for more information concerning firewalls and external network connections.

Standard Features

- **Multiple Connection Options**
  Hot pluggable SFP-style network controllers allow selection of twisted pair, fiber optic and CAT cables.
- **Supports multiple network configurations**
  Networks can be configured in Class B, Class A, Class X and Class N.
- **IPv6 Support**
  Autoconfiguring network for simple setup and easy network configuration.

DATA SHEET E85014-0008
Not to be used for installation purposes. Issue 3.0

Application

EST4 life safety communication is built on a self-configuring IPv6 network. 4-NET series SFP network controller modules provide the connection to physical inter-panel cabling. All SFPs are hot-swappable and mount in either of the two SFP slots found on 4-CPU, 4-ANNCPU, 4-CPUGRPH and 4-NET-AD modules.

Capacity for Large Projects

Robust physical interconnections facilitate a range of liberating network capacities. Twisted pair copper at 2 Mbps supports distances of up to 5,000 ft. (1.5 km) between any two panels; up to 50,000 ft. (15 km) at 0.2 Mbps when used with the 4-NET-XT. Single-mode, multimode, and even CAT 5 (or better) cable solutions are also available.

A single network cable carries all panel-to-panel services: data, voice audio, and firefighters' telephone. No separate interconnections are needed. This powerful feature reduces cable costs and installation time.

Powerful Network Security and Survivability

Cabling options satisfy even the most demanding redundancy and survivability requirements. The EST4 network can be configured for Class A, Class B, Class X, and Class N wiring. CAT5 installations are not limited to Class N wiring style: the network can be designed to meet Class A, Class B, and Class X configuration with CAT5 cable.

Network messages received by 4-NET controllers are routed by the CPU to the appropriate network link. As each link is an independent point-to-point connection wire run lengths between nodes are maximized.

Failsafe mechanisms are built right into EST4 network controllers. Should a connected CPU module go offline, the input and output ports automatically connect directly to one another. This operation provides a pass-through mode that maintains basic connectivity in the event of something as mundane as a routine power-down for servicing, or as catastrophic as the failure of a control panel.

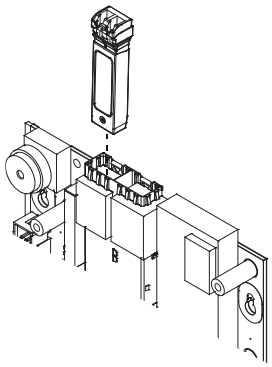
The EST4 life safety network is a self-configuring IPv6 network that enables the full support for cybersecurity tested to meet FIPS publication 197. Salted Hashing of passwords, authentication and encryption of sensitive data (user PINs, node authentication) are all standard features. This security applies to a single panel or the full complement of nodes that the EST4 network can support.

SFP Passthrough Support, eth0 to eth1

	4-NET-CAT	4-NET-(fiber type)	4-NET-TP	4-NET-TP-HC
4-NET-CAT	✓	✓	✓	✓
4-NET-(fiber type)	✓	✓	✓	✓
4-NET-TP	✓	✓	✓	
4-NET-TP-HC	✓	✓		✓

Installation

4-NET controllers mount into any EST4 panel on the life safety network by simply plugging into either of the two slots found on the 4-CPU, 4-ANNCPU, 4-CPUGRPH or 4-NET-AD modules. The controllers are hot-swappable and may be combined to provide fiber, twisted-pair, or CAT5/6 connections as needed.



Engineering Specification

The system shall support communicating on a TCP/IP, IPv6 network that supports multiple network topologies including any mix of ring, bus, star and mesh. The network shall support physical media connections via fiber, twisted pair or CAT5 in any combination. The Network shall support data transmission of panel-to-panel data, voice audio and firefighters' telephone data on a single twisted pair or single optical fiber. The Network shall be configured as <Class A> <Class B> <Class X>. Networks restricted to Class N wiring shall not be acceptable. Network shall support a back-to-back pass through mode that maintains network connectivity on power down for servicing or catastrophic failure of a single panel.

For retrofit of existing installations the system shall support reuse of existing network wiring that meets the minimum wiring specification of the specified SFP controller, is electrically sound and is acceptable to the Authority Having Jurisdiction.

Technical Specifications

SFP Twisted Pair Specifications

	4-NET-TP	4-NET-TP-HC
Current	32mA at 24Vdc	
Circuit Capacitance	0.09 µF max. between two nodes	0.3 µF max. between two nodes
Data speed	2 Mbps TX/RX	0.3 Mbps TX/RX
Maximum Resistance	90 ohms	
Operating Temperature	32 to 120 °F (0 to 49 °C)	
Operating relative humidity	0 to 93% noncondensing	
Wire Size	One twisted pair, six twists per foot minimum, 16 to 24 AWG (1.3 to 0.20 mm²)	
Cable Connector type	Push-in, self clamping terminal block	
Agency Listings	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept.	UL, ULC, FM, CSFM, NYC Fire Dept.
Circuit Length	5,000 ft. (1,524 m) between any two nodes	
Data supported	Network, Voice Audio, Firefighters' Telephone, Pre-recorded messages.	Network, One channel Voice Audio, Pre-recorded messages.

SFP CAT Cabling Specifications

4-NET-CAT	
Voltage	
Current	45 mA at 24 VDC
Data Speed	100 Mbps TX/RX
Operating Temperature	32 to 120°F (0 to 49°C)
Operating Relative Humidity	0 to 93% noncondensing
Cable Supported	Cat 5e or better
Cable Connector Type	RJ-45
Agency Listings	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept.
Circuit Length	328 ft. (100 m) max.
Data supported	Network, Voice Audio, Firefighters' Telephone
Cable Rating	Fire or plenum

4-NET-TP using CAT 5e or better cable	
Voltage	
Current	45 mA at 24 VDC
Circuit Capacitance	N/A
Circuit Resistance	N/A
Data Speed	2 Mbps TX and RX
Operating Temperature	32 to 120 °F (0 to 49 °C)
Operating Relative Humidity	0 to 93% noncondensing
Wire size	22 to 24 AWG
Cable Connector Type	terminal block
Agency Listing	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept.
Circuit Length	3280 ft (1,000m)
Data Support	Network, Voice Audio, Firefighters' Telephone
Cable Rating	Fire or plenum

SFP Cabling Specifications

SFP network controller	Wavelength (nm)	Fiber type	Core size (microns) [1]	Modal bandwidth (Mhz/km) [2]	Cable distance Miles (km)
4-NET-MM [2]	1310	OM1/OM2	62.5um/50um	500	1.24 miles (2 km)
4-NET-SM	1310	G.652	9	N/A	8.7 miles (14 km)
4-NET-SMH	1310	G.652	9	N/A	24.8 miles (40 km)
4-NET-SMU	1310	G.652	9	N/A	6.2 miles (10 km)
4-NET-SMD	1550	G.652	9	N/A	6.2 miles (10 km)

[1] G.652, listed under core size for single mode fiber (SMF), refers to an ITU-T standard of commonly deployed non-dispersion-shifted single mode fiber with a core size of approximately 8 to 10 microns (µm).

[2] The maximum cable distance will be reduced when using fibers with less than 500 MHz/km bandwidth. For example, a 62.5u/125u step-index fiber may have a modal bandwidth as low as 160 MHz/km. This translates to a maximum 100Base link length of about 640 m. If 100u core fiber is installed, the length could be reduced to about 150 m.

SFP Optical Specifications

SFP network controller	Transceiver type	Transmit power (dBm)		Receive power (dBm)		Max channel insertion loss in dB (by fiber type) [1]	Transmit and receive wavelength (nm)
		Min	Max	Min	Max		
4-NET-MM	100Base-FX	-20	-14	-31	-14	10 (62.5/125um OM1)	1300/1300
4-NET-MM	100Base-FX	-20	-14	-31	-14	5 (50/125um OM2)	1300/1300
4-NET-SM	100Base-LX10	-15	-8	-25	-8	5	1310/1310
4-NET-SMH [2]	100Base-LX40	-5	0	-33	-10	25 (10 dB min)	1310/1310
4-NET-SMU	100Base-BX10-U	-14	-8	-27	-8	5	1310/1550
4-NET-SMD	100Base-BX10-D	-14	-8	-27	-8	5	1550/1310

[1] Maximum channel insertion loss is defined for maximum distance guaranteed as specified in the Cabling Specifications table above and by fiber type/core diameter. When links are deployed over shorter distances, additional channel insertion loss may be allowed. Actual performance may allow greater insertion loss.

[2] 4-NET-SMH requires a minimum 10db insertions loss. If the insertion loss is less than 10db, a single mode attenuator is required to obtain the minimum 10db loss.

4-NET- fiber optic SFPs	
Current	
Standby/Alarm	5 mA at 24 VDC
Data speed	100 Mbps TX/RX
Operating Temperature	32 to 120°F (0 to 49°C)
Operating Relative humidity	0 to 93% noncondensing
Cable Specification	See *SFP Cabling Specifications* above.
Cable Connector type	LC simplex for 4-NET-SMU and 4-NET-SMD, LC duplex, for all other fiber controllers
Agency Listings	UL, ULC, FM, CSFM, EN54, CE, NYC Fire Dept.

LIFE SAFETY & INCIDENT MANAGEMENT

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Website: edwardsfiresafety.com

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Ordering Information

Model # (SKU)	Description	Shipping Weight
4-NET-TP	SFP Network Controller, 2Mbps Shared TX/RX, Twisted Pair or Cat 5.	0.2lb (0.091kg)
4-NET-TP-HC[1] (Not approved for EN54 applications)	SFP Network Controller, 0.3Mbps Shared TX/RX, High Capacitance Twisted Pair	0.2lb (0.091kg)
4-NET-MM	SFP Network Controller, Multimode, Dual-Fiber, 100Base-FX 1310nm	0.248lb (0.112kg)
4-NET-SM	SFP Network Controller, Single-Mode, Dual-Fiber, 100Base-LX10 1310nm	0.248lb (0.112kg)
4-NET-SMD	SFP Network Controller, Single-Mode, Single-Fiber, Downlink, 100Base-BX10-D 1550nm/1310nm Tx/Rx, works with 4-NET-SMU	0.248lb (0.112kg)
4-NET-SMU	SFP Network Controller, Single-Mode, Single-Fiber, Uplink, 100Base-BX10-U 1310nm/1550nm Tx/Rx works with 4-NET-SMD	0.248lb (0.112kg)
4-NET-SMH	SFP Network Controller, Single-Mode, Dual-Fiber, 100Base-High Output 1310nm,	0.248lb (0.112kg)
4-NET-CAT	SFP Network Controller, CAT5 UTP Copper, 100Base-TX, 100Mbps	0.2lb (0.091kg)

[1] Not for use with new installations.
Note 1: Unless otherwise specified, all SKUs may be used in EN54/UL/ULC applications

LIFE SAFETY & INCIDENT MANAGEMENT

EST4 Remote Annunciators

4-xxANN Series



4-2ANN and 4-4ANN shown with optional equipment.

FM APPROVED NYC FIRE DEPT. COA # 6314 UL ULC

7120-1657: 0509

Overview

EST4 Remote Annunciators provide front panel system status and control functions located conveniently anywhere on the EST4 network. Annunciators can be as simple as a couple of LED indicator strips, or complex enough to support up to two LCD displays, an audio telephone interface, and hundreds of control points and indicators — all in a single enclosure.

Up to 576 tactile switches and 576 LED indicators may be mounted in a single EST4 annunciator cabinet. Control Display Modules (CDMs), comprise a column of programmable buttons accompanied by one or two LED indicator positions per button. Indicator-only modules hold up to 24 indicators. Switch and indicator module LEDs can be set to any of five colors, providing an additional level of feedback.

All remote annunciators feature color-matched cabinets and distinctive metallic bronze (Pantone Coated PMS# P 171-16 C, Pantone RGB# 81 75 67, and RAL Classic/RAL Design# 7022) doors for a readily-identifiable and consistent look throughout the facility.

Thanks to EST4's ingenious communications protocol, network data — as well as telephone and audio data — is carried on a single fiber optic cable or twisted wire pair. This multi-use capacity has an enormous cost-savings potential compared with conventional audio transmission, reducing not only installation costs, but also simplifying ongoing system maintenance.

Slide-in LED and switch labeling makes it easy to incorporate right into the annunciator design such information aids as descriptive text, color-coding, icons, and local languages. For custom floorplans or facility maps, EST4 offers LED driver boards perfectly suited to operate in most graphic annunciators.

Standard Features

- **Connection Over High-speed Life Safety Network**
  Annunciator network and audio data carried on a single fiber or twisted pair.
- **Optional Color LCD Display**
  Touch screen capability supplements control buttons for quick, intuitive access to key system status and control functions.
- **Wide Range of Annunciator Configurations**
  From a two-slot model holding a single LCD display to 24-slot cabinets for complex annunciation.
- **Supports Two LCD Displays**
  Providing users with a simplified sequence of operations.
- **Convenient Programming**
  Built-in support for radio groups of up to 24 switches in size.
- **Slide-in Switch and Indicator Labels**
  A simple, effective means to customize annunciator appearance and messaging.
- **Programmable LED Flash Rates and Colors**
  Easy to see, quick to understand.
- **Clean and robust door designs**
- **Support for all Common Networking Media**
  Annunciators connect over any combination of twisted pair wire, Multi-mode fiber, Single Mode fiber, and even CAT5 cable.

Application

Use EST4 remote annunciators where a compact system status display is needed. Annunciator configuration can range from a couple of LED indicator strips, to complex arrangements supporting in a single enclosure up to two LCD displays, paging microphone, firefighter telephone and hundreds of control points and indicators.

EST4 annunciators support a range of options that make them ideal for Mass Notification, Life Safety and other emergency communications purposes. They can be used as Central Control Stations (CCS), Autonomous Control Units (ACU), Local Operating Console (LOC), and combination units from which initiated Mass Notification functions can be controlled.

Cabinets may be surface or semi-flush mounted for installation expediency and aesthetic appeal.

Annunciators connect over the high-speed EST4 network, which supports copper or fiber-optic communications in any combination. Network data and audio data share the same cabling. This results in more efficient deployment with fewer cables needed and fewer connections to be made.

The 2 wide, 4 wide, and 6 wide, 4-xANNMT series, annunciator wallboxes come standard with surface mounting trims and semi-flush mounting trims.

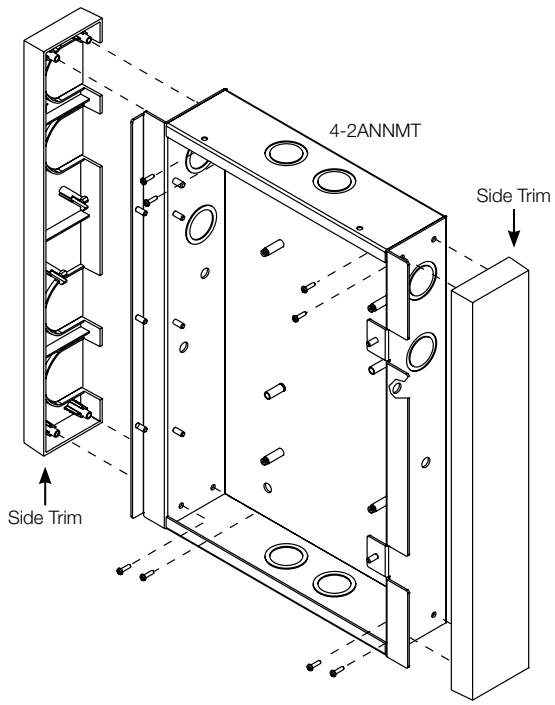
The 8 space, 16 space and 24 space 4-xxANNMT series wallboxes are designed for surface mount applications. Their depth is kept to a minimum to allow the least amount of room penetration. When semi-flush mounting is required, order the standard 3-CAB5B, 7B, or 14B wallbox.

Engineering Specification

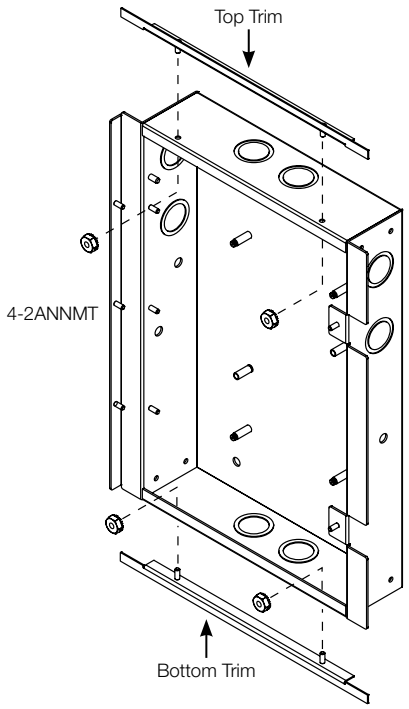
The Life Safety system shall incorporate annunciation of Alarm, Supervisory, Trouble and Monitor operations. Annunciation must be through the use of both LED display strips complete with a means to custom label each LED as to its function. LED color shall be selectable at configuration time. Where applicable control switches must be provided. Switches with LEDs must provide positive feed back to the operator of remote equipment status. A color touchscreen LCD display with basic common control LEDs and switches shall be provided. Optionally a second color touchscreen display may be added to support audio and telephone operations. The Common Control Switches and LEDs provided as minimum will be: Reset switch and LED, Alarm Silence switch and LED, Panel Silence switch and LED, Drill switch and LED. It must be possible to add additional common controls as required through the use of modular display / control units. The LCD must provide the emergency user, hands free viewing of the first highest priority event. System events must automatically be placed in queues. It shall be possible to view specific event types separately. The total number of active events by type must be displayed. It must be possible to customize the designations of all user interface LEDs and switches for local language requirements. It must be possible to route system event messages to specific annunciator locations. It must be possible for the annunciator to contain a paging microphone and fire fighter telephone.

Installation and Mounting

4-2ANNMT, 4-4ANNMT, and 4-6ANNMT included side trim installation for surface mount applications



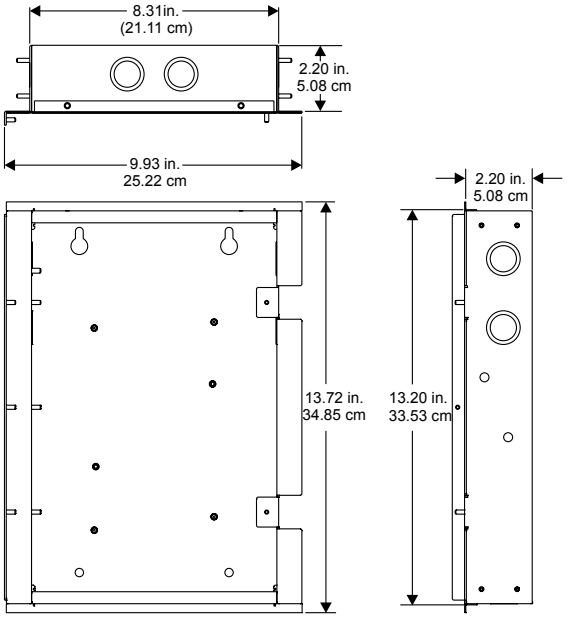
4-2ANNMT, 4-4ANNMT, and 4-6ANNMT included trim installation for semi-flush mount applications



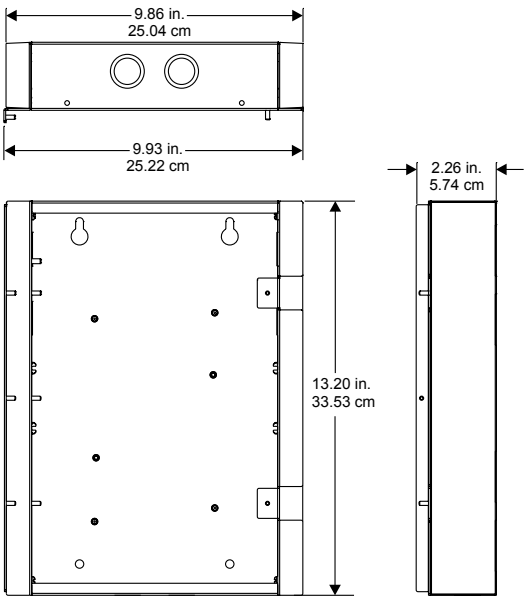
See Specifications Table for 4-8ANNMT, 4-16ANNMT, 4-24ANNMT mounting options.

Dimensions, wallboxes

4-2ANNMT Wallbox Assembly, Surface and Semi-flush Mounting (both trims are included)

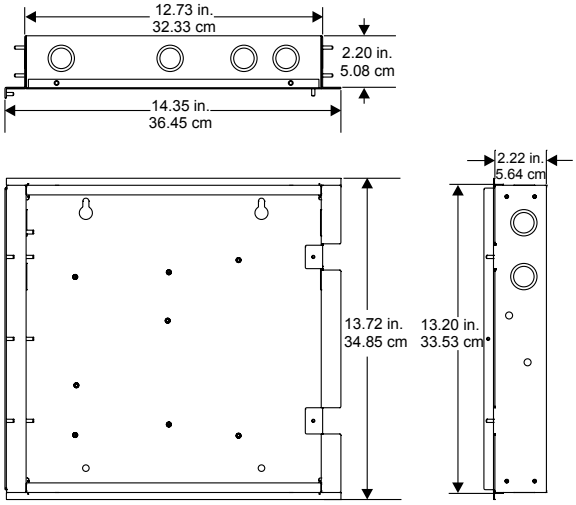


Semi-flush mount (trim installed top and bottom)

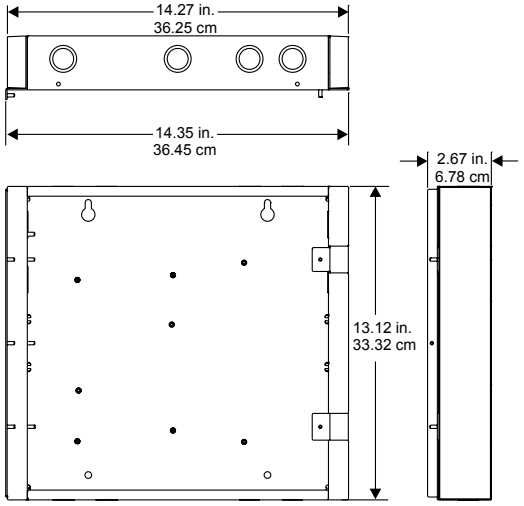


Surface mount (trim installed right and left sides)

4-4ANNMT Wallbox Assembly, Surface and Semi-flush Mounting (both trims are included)

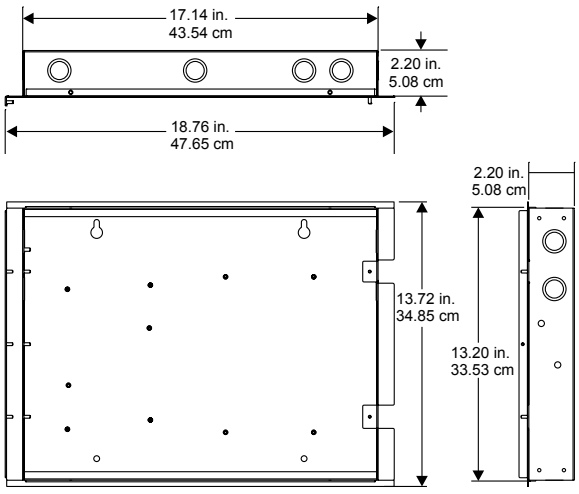


Semi-flush mount (trim installed top and bottom)

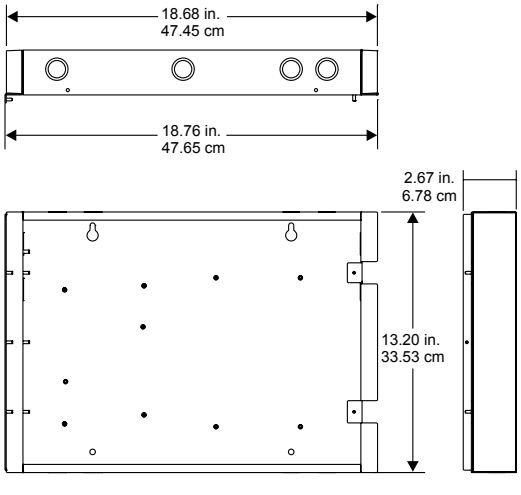


Surface mount (trim installed right and left sides)

4-6ANNMT Wallbox Assembly, Surface and Semi-flush Mounting (both trims are included)



Semi-flush mount (trim installed top and bottom)

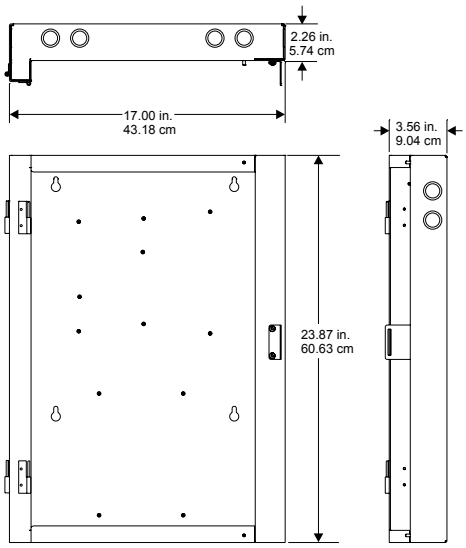


Surface mount (trim installed right and left sides)

Dimensions, wallboxes

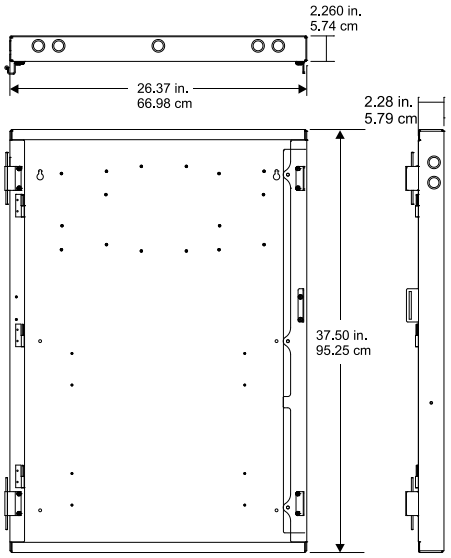
4-8ANNMT Wallbox Assembly, Surface Mount

For semi-flush mounting, use a 3-CAB5B wallbox.



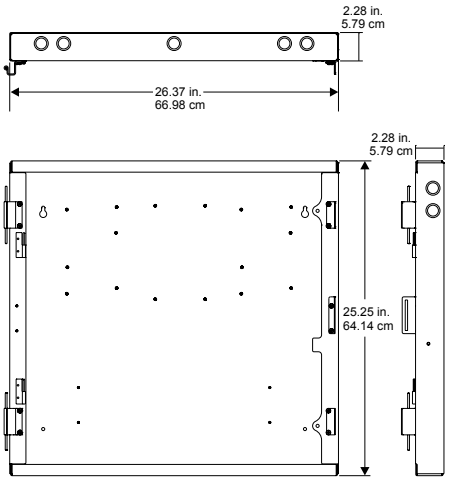
4-24ANNMT Wallbox Assembly, Surface Mount

For semi-flush mounting, use a 3-CAB14B wallbox.



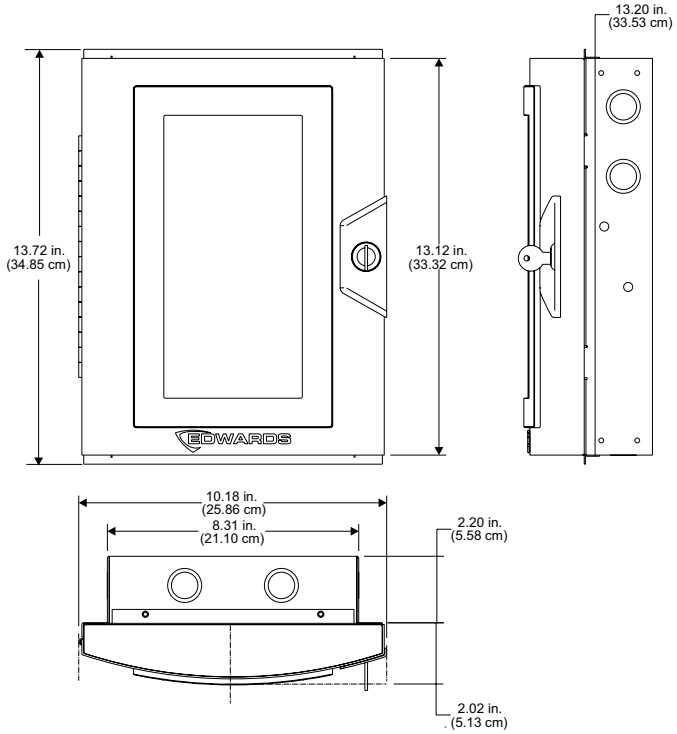
4-16ANNMT Wallbox Assembly, Surface Mount

For semi-flush mounting, use a 3-CAB7B wallbox.

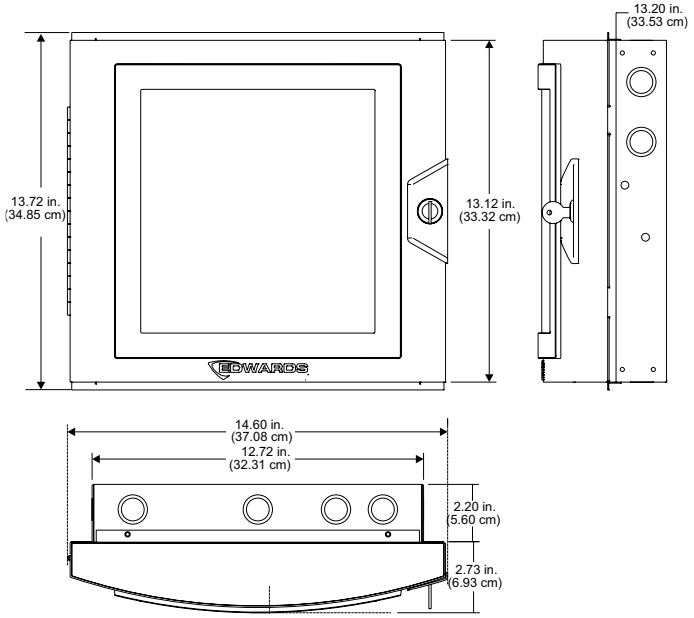


Dimensions, door assemblies

4-2ANN Series Door Assembly

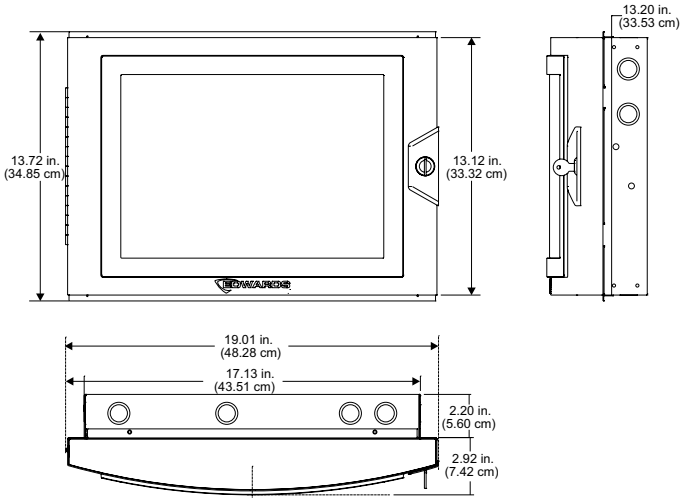


4-4ANN Series Door Assembly

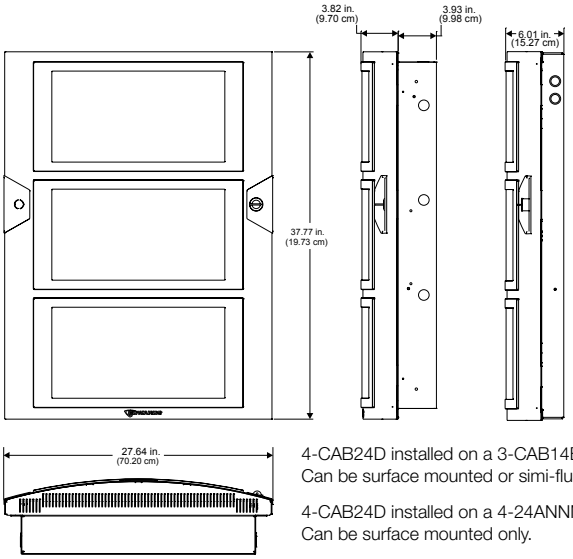


Dimensions, door assemblies continued

4-6ANN Series Door Assembly



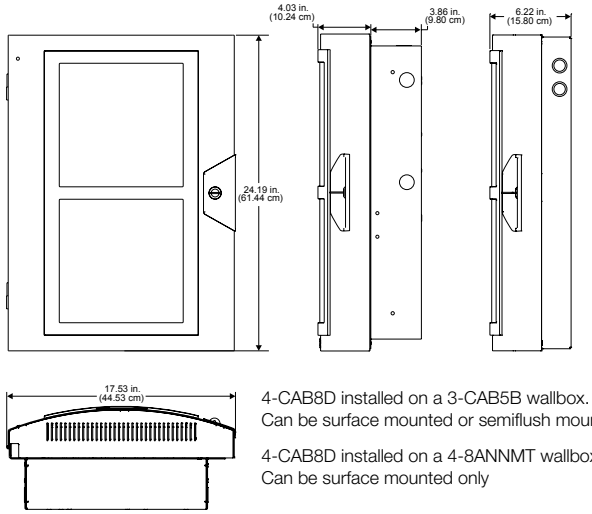
4-CAB24D Series Door Assembly



4-CAB24D installed on a 3-CAB14B wallbox.
Can be surface mounted or simi-flush mounted.

4-CAB24D installed on a 4-24ANNMT wallbox.
Can be surface mounted only.

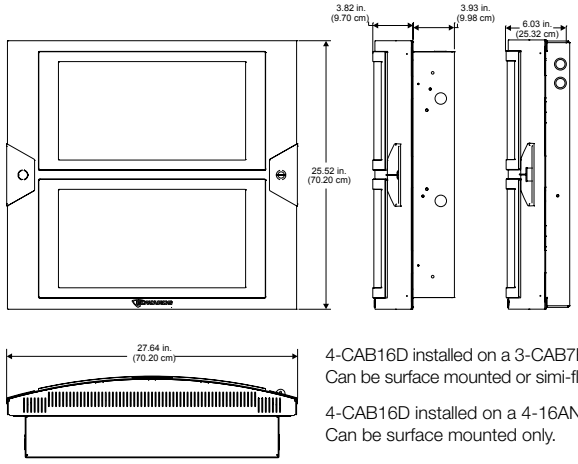
4-CAB8D Series Door Assembly



4-CAB8D installed on a 3-CAB5B wallbox.
Can be surface mounted or semiflush mounted.

4-CAB8D installed on a 4-8ANNMT wallbox.
Can be surface mounted only

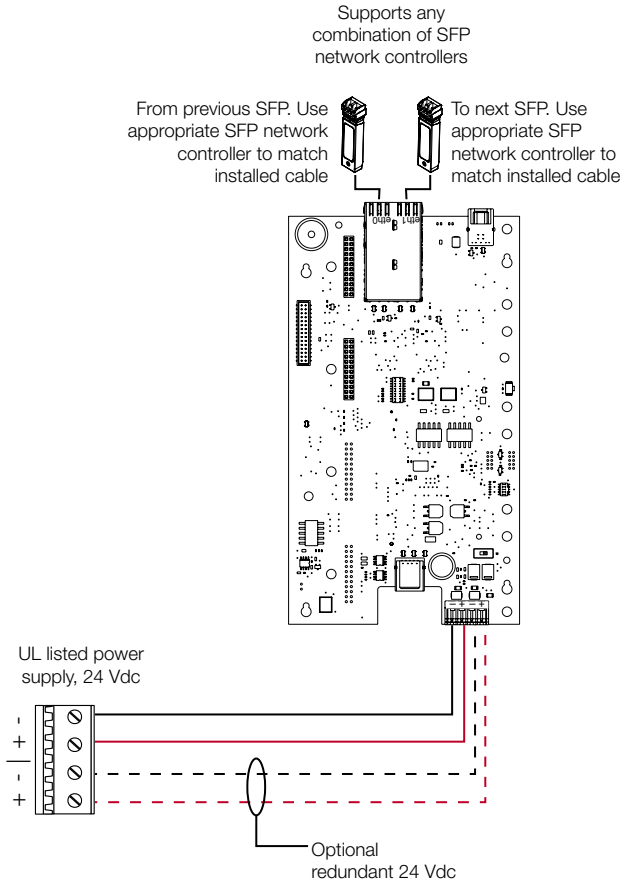
4-CAB16D Series Door Assembly



4-CAB16D installed on a 3-CAB7B wallbox.
Can be surface mounted or simi-flush mounted.

4-CAB16D installed on a 4-16ANNMT wallbox.
Can be surface mounted only.

Wiring



SFP Network Controllers

Model #	Description	Network Interconnection Media Supported
4-NET-CAT	100 Mbps SFP Network Controller	Cable type - Cat 5e or better Connector type - RJ-45 Distance 328 ft. (100 m) max
4-NET-MM	Multi-mode fiber-optic SFP Network Controller	SFP network media interface, multi-mode fiber-optic, supports 50/125 µ (OM3/OM4) fiber pair up to 1.24 mi. (2 km), 62.5/125 µ (OM1) fiber pair up to 0.62 mi. (1 km), or a 100/140 µ fiber pair up to 150 m. Order one 4-NET-MM for “in” wiring and one for "out" wiring for connections from previous node and to next node as required. Each 4-NET-MM supports one multi-mode fiber pair between network cards.
4-NET-SM	Single-mode fiber-optic SFP Network Controller	Single mode 9/125 µ (G.652) fiber pair up to 6.2 miles (10 km). Order one 4-NET-SM for “in” wiring from the previous node and a second 4-NET-SM for “out” network wiring to the next node. Each 4-NET-SM supports one single-mode fiber pair between network cards
4-NET-SMH	Single-mode fiber-optic SFP Network Controller High output	Single-mode fiber-optic, high-power output, with a 9/125 µ (G.652) fiber pair up to 24.8 mi (40km). Order one 4-NET-SMH for “in” wiring from the previous node and a second 4-NET-SMH for “out” network wiring to the next node. Each 4-NET-SMH supports one single-mode fiber pair between network cards.
4-NET-SMU	Single-mode fiber-optic SFP Network Controller Bi-Directional	Bi-directional, single-mode fiber-optic with a 9/125 µ (G.652) fiber up to 6.2 miles (10 km). The 4-NET-SMU must be paired with a 4-NET-SMD over one single-mode fiber between network cards.
4-NET-SMD	Single-mode fiber-optic SFP Network Controller Bi-Directional	Bi-directional, single-mode fiber-optic with a 9/125 µ (G.652) fiber up to 6.2 miles (10 km). The 4-NET-SMD must be paired with a 4-NET-SMU over one single-mode fiber between network cards.
4-NET-TP	2 Mbps Twisted Pair SFP Network Controller	Twisted pair. Following specifications are between any two panels. • 16 to 22 AWG (1.3 to 0.33 mm²) • Six twists per foot minimum • Circuit Capacitance 0.09 µF max. • 5,000 ft. (1,524 m) between any two panels • Circuit resistance 90 Ω max.
4-NET-TP-HC	0.3 Mbps Twisted Pair SFP Network Controller	Twisted pair or Shielded twisted pair. Following specifications are between any two panels. • 16 to 24 AWG (1.3 to 0.20 mm²) • Six twists per foot minimum • 5,000 ft. (1,524 m) between any two nodes with unshielded twisted pair • Circuit capacitance 0.3 µF max. • 3280 ft. (1,000 m) between any two nodes shielded twisted pair • Circuit resistance 90 Ω max.

Refer to Data Sheet E85014-0008 for additional details on SFP network controllers.

Technical Specifications

Annunciator Assemblies

Each annunciator space holds a control-display module. LCD displays, 4-MIC and 4-FT take two spaces.

	4-2ANN	4-4ANN	4-6ANN	4-8ANN	4-16ANN	4-24ANN
Number of Spaces	Two	Four	Six	Eight	Sixteen	Twenty-four
Wallbox, Surface Mounting	4-2ANNMT	4-4ANNMT	4-ANNMT	4-8ANNMT	4-16ANNMT	4-24ANNMT
Wallbox, Semi-flush Mounting				3-CAB5B	3-CAB7B	3-CAB14B
Agency Approvals:	UL, ULC, FM, CSFM					
Door Color	Metallic Bronze (Pantone Coated PMS# P 171-16 C, Pantone RGB# 81 75 67, and RAL Classic/RAL Design# 7022)					
Wallbox Color	Black					

4-ANNCPU Central Processor

Comes standard with annunciator assemblies.

Voltage	16 to 32Vdc
Current draw Standby Alarm/Active	 183 mA at 16 VDC; 125 mA at 24 VDC; 119 mA at 32 VDC 188 mA at 16 VDC; 125 mA at 24 VDC; 124 mA at 32 VDC
USB support	One USB 3.0, Type A – female port One USB 3.0, Type B – female port
SFP support	Supports all 4-NET series SFPs. Refer to EST4 Network Controllers Catalog sheet 85014-0008 for details.
Wire Size	TB1 backup power connection 12 to 18 AWG (2.5 to 1.0 mm²)
Operating Temperature	32 to 120°F (0 to 49°C)
Operating relative Humidity	0 to 93% noncondensing
Option modules	4-ANNAUDTEL: Annunciator Audio/Telephone interface module. Adds audio and telephone processing capabilities to the 4-ANNCPU, required for the use of the 4-MIC and/or 4-FT with the 4-ANNCPU.

Ordering Information, annunciators and accessories

Model # (SKU)	Description	Shipping Weight
4-2ANN	LCD Annunciator - Comes with 4-LCDANN color touchscreen display, 4-ANNCPU, metallic bronze outer door and black inner door. Order wallbox assembly model 4-2ANNMT and required network Controllers 4-NET-XX separately (see Note 1).	10.3lb (4.67kg)
4-4ANN	Metallic bronze Annunciator supports 4 slots (1 row of 4). Comes with 4-ANNCPU, metallic bronze outer door and black inner door. Order wall Mounting assembly 4-4ANNMT, required network controllers 4-NET-XX series (See note 1), any user interfaces and filler plates separately.	11.5lb (5.22kg)
4-6ANN	Metallic bronze Annunciator, 6 slots (1 row of 6). Comes with 4-ANNCPU, metallic bronze outer door and black inner door. Order wall Mounting assembly 4-6ANNMT, required network Controllers 4-NET-XX series (see Note 1), any user interfaces and required filler plates separately.	12.5lb (5.67kg)
4-8ANN	Metallic bronze Annunciator, 8 slots (2 rows of 4). Comes with 4-ANNCPU, metallic bronze outer and black inner doors. Order wall Mounting assembly 4-8ANNMT (surface mounting), or 3-CAB5B (Semi-flush mounting) required network Controllers 4-NET-XX series (see Note 1), End User interfaces and required filler plates separately.	24.5lb (11.11kg)
4-16ANN	Metallic bronze Annunciator, 16 slots (2 rows of 8). Comes with 4-ANNCPU, metallic bronze outer and black inner doors. Order wall Mounting assembly 4-16ANNMT (Surface mount) or 3-CAB7B (semi-flush mount), required network Controllers 4-NET-XX series (see Note 1), end user interfaces and required filler plates separately.	37.9lb (17.19kg)
4-24ANN	Metallic bronze Annunciator, 24 slots (3 rows of 8). Comes with 4-ANNCPU, metallic bronze outer and black inner doors. Order wall mounting assembly 4-24ANNMT, required network Controllers 4-NET-XX series (see Note 1), and End User interfaces and required filler plates separately.	52.9lb (24.02kg)
Accessories and Related Equipment		
4-LCDANN	Color LCD display, includes silicon rubber common control buttons, mounts in remote annunciators, communicates to 4-ANNCPU. Comes with interconnect cable. LCD ordered separately for mounting in 4-4ANN or 4-6ANN. 4-2ANN comes with one 4-LCDANN.	1.90lb (0.85kg)
4-LCDLE	Color LCD display, includes silicon rubber common control buttons, mounts in remote annunciators sizes 4-8ANN, 4-16ANN or 4-24ANN, communicates to 4-ANNCPU. Comes with interconnect cable	1.9lb (0.85kg)
4-LCDAUD TELANN	LCD display for control of paging and fire fighter telephone. Comes with one 4-LCDAUDTEL and mounting and cabling hardware for mounting in 4-16ANNMT or 4-24ANNMT enclosures where separate LCD display of Audio and Telephone is required. Is not supported in other annunciator sizes. Order annunciator application specific equipment separately.	1.8lb (0.81kg)
4-ANNCPU	Annunciator Central Processor Unit (CPU), provides mounting for up to two network controllers (see note 1), one USB device port, one USB host port and one 4-ANNAUDTEL module.	1.0lb (0.45kg)
4-24L	Control Display Module with 24 indicators. See note 2.	0.6lb (0.27kg)
4-24L12S	Control Display Module with 24 indicators and 12 switches. See Note 2.	0.7lb (0.29kg)
4-24L18S	Control Display Module with - 24 indicators and 18 switches See Note 2.	0.7lb (0.29kg)
~~4-24L24S~~	Control Display Module with - 24 indicators and 24 switches. See Note 2. NOT REQUIRED THIS JOB	0.7lb (0.29kg)
4-FIL x4	Fills one indicator/switch space on inner doors when no Switch or LED strips are installed.	0.1lb (0.04kg)
~~4-MIC~~	Audio paging microphone. Requires 4-ANNAUDTEL support card be installed on the 4-ANNCPU card. Can be mounted in 4-4ANN through 4-24ANN annunciators NOT REQUIRED THIS JOB	1.2lb (0.54kg)
4-FT	Master Fire Fighters telephone. Requires a 4-ANNAUDTEL support card be installed on the 4-ANNCPU card. Can be mounted in 4-4ANN through 4-24ANN annunciators.	1.4lb (0.64kg)
4-ANN AUDTEL	Annunciator Audio/Telephone interface module. Adds audio and telephone processing capabilities to the 4-ANNCPU, required for the use of the 4-MIC and/or 4-FT with the 4-ANNCPU.	0.3lb (0.14kg)
4-CPUGRPH	Graphic Annunciator Central Processor Module. See Note 3.	1.5lb (0.68kg)
3-EVDVR	LED/SWITCH Driver Module Assembly for ENVOY graphics. See Note 3.	0.4lb (0.18kg)
3-EVDVRA	LED/SWITCH Driver Module Assembly for Third-party Graphics. See Note 3.	0.7lb (0.32kg)
3-EVPWR	Power Supply Assembly space for one 4-CPUGRPH for ENVOY Graphics. See Note 3.	0.2lb (0.09kg)
3-EVPWRA	Power Supply Assembly c/w 19 inch rail mounting chassis assembly space for one 4-CPUGRPH for Third-party Graphics. See Note 3.	2.9lb (1.34kg)
3-EVDVRX	Plastic mounting extrusion 19” mounting - for up to 3 3-EVDVRAs. See Note 3.	0.9lb (0.41kg)

Note 1: Refer to Catalog Sheet part number E85014-0008 for a complete list and description of available Network Controllers.
Note 2: Refer to Catalog Sheet part number E85014-0006 for a complete description of Control Display Modules.
Note 3: SKU not FM approved.

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

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Bradenton, FL 34202

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Ordering Information, wallboxes and replacement parts

Model # (SKU)	Description	Shipping Weight
Wallboxes		
4-2ANNMT	Mounting assembly for 4-2ANN, two wide annunciator. Supports surface or semi-flush mounting. Comes with black wallbox, surface mounting plastic fillers and semi-flush trim.	6.4lb (2.9kg)
4-4ANNMT	Mounting assembly for 4-4ANN, four wide annunciator. Supports surface or semi-flush mounting. Comes with black wallbox, surface mounting plastic fillers and semi-flush trim.	9.0lb (4.08kg)
4-6ANNMT	Mounting assembly for 4-6ANN, six wide annunciator. Supports surface or semi-flush mounting. Comes with wallbox, surface mounting plastic fillers and semi-flush trip.	10.3lb (4.67kg)
4-8ANNMT	Mounting assembly for 4-8ANN, four wide x two row high annunciator. Supports surface mounting.	19.0lb (8.62kg)
3-CAB5B	Wallbox – Black Semi-flush wallbox, ideal for use when semi-flush mounting 4-8ANN annunciators.	20.0lb (9.07kg)
4-16ANNMT	Surface Mount Wall box assembly for eight wide by two high annunciators (16 spaces)	27.0lb(12.25kg)
3-CAB7B	Wallbox – Black Semi-flush wallbox, ideal for use when semi-flush mounting 4-16ANN annunciators.	29.5lb (13.38kg)
4-24ANNMT	Surface mount wallbox assembly for eight wide by three high annunciator (24 spaces).	37.0lb (16.78kg)
3-CAB14B	Wallbox – Black Semi-flush wallbox, ideal for use when semi-flush mounting 4-24ANN annunciators.	40.8lb (18.5kg)
Service Replacement Parts		
4-2ANND	Service replacement metallic bronze Annunciator Door for 4-2ANN annunciators includes the inner and outer doors.	7.7lb (3.5kg)
4-4ANND	Service replacement metallic bronze Annunciator Door for 4-4ANN annunciators includes the inner and outer doors.	10lb (4.5kg)
4-6ANND	Service replacement metallic bronze Annunciator Door for 4-6ANN annunciators, includes the inner and outer door	11lb (5kg)
4-CAB8D	Service replacement metallic bronze door for 3-CAB5B or 4-8ANNMT - four spaces wide by two high (8 spaces) Includes inner (black) door and outer metallic bronze door.	23lb (10.4kg)
4-CAB8DR	Red door for 3-CAB5B - four spaces wide by two high (8 spaces). Includes inner (black) door and outer red door. May be used to provide a red door for 4-8ANN annunciators.	23lb (10.4kg)
4-CAB16DR	Red door for 3-CAB7B - eight spaces wide by two high (16 spaces). Includes inner (black) door and outer red door. May be used to provide a red door for 4-16ANN annunciators.	36lb (16.3kg)
4-CAB24DR	Red door for 3-CAB14B - eight spaces wide by three high (24 spaces). Includes inner (black) door and outer red door. May be used to provide a red door for 4-24ANN annunciators	51lb (23.1kg)
4-2ANNFA	Service replacement part - plastic frame assembly with mounting screws for 4-2ANN annunciators	1.5lb (0.68kg)
4-4ANNFA	Service replacement part - plastic frame assembly with mounting screws for 4-4ANN annunciators.	2lb (0.91kg)
4-6ANNFA	Service replacement part - plastic frame assembly with mounting screws for 4-6ANN annunciators.	2lb (0.91kg)
4-4X2ANNFA	Service replacement part – plastic frame assembly with mounting screws for 4-8ANN annunciators and 4-CAB5D door assemblies.	3lb (1.36kg)
4-8ANNFA	Service replacement part - plastic frame assembly with mounting screws for 4-CAB16D and 4-CAB21D(L) door assemblies.	3lb (1.36kg)

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Remote Booster Power Supplies

BPS6A, BPS10A



FM APPROVED
MEA 476-91-E Vol.13
UL UL S3424
7300-1657: 0229

Overview

The Booster Power Supply (BPS) is a UL 864, 10th Edition listed power supply. It is a 24 Vdc filtered-regulated, and supervised unit that can easily be configured to provide additional notification appliance circuits (NACs) or auxiliary power for Mass Notification/ Emergency Communication (MNEC), as well as life safety applications.

The BPS contains the circuitry to monitor and charge internal or external batteries. Its steel enclosure has room for up to two 10 ampere-hour batteries. The BPS has four Class B (convertible to two Class A) NACs. These can be activated in one or two groups from the BPS's unique dual input circuits.

The BPS is available in 6.5 or 10 ampere models. Each output circuit has a capacity of three amperes; total current draw cannot exceed the unit's rating.

The BPS meets current UL requirements and is listed under the following standards:

Standard (CCN)	Description
UL864 10th edition (UOXX)	Fire Alarm Systems
UL636 (ANET, UEHX7)	Holdup Alarm Units and Systems
UL609 (AOTX, AOTX7)	Local Burglar Alarm Units and Systems
UL365 (APAW, APAW7)	Police Station Connected Burglar Alarm Units and Systems
UL1076 (APOU, APOU7)	Proprietary Burglar Alarm System Units
UL1610 (AMCX)	Central Station Alarm Unit
ULC-S527 (UOXXC)	Control Units, Fire Alarm (Canada)
ULC-S303 (AOTX7)	Local Burglar Alarm Units and Systems (Canada)
C22.2 No. 205	Signaling Equipment (Canada)

Standard Features

- Allows for reliable filtered and regulated power to be installed where needed
- Cost effective system expansion
- Provides for Genesis and Enhanced Integrity notification appliance synchronization
- Supports coded output operation
- Self-restoring overcurrent protection
- Multiple signal rates
- Can be cascaded or controlled independently
- Easy field configuration
- On-board diagnostic LEDs identify wiring or internal faults
- Standard EDWARDS keyed lockable steel cabinet with removable door
- 110 and 230 Vac models available
- Accommodates 18 to 12 AWG wire sizes
- Optional tamper switch
- Dual battery charging rates
- Optional earthquake hardening: OSHPD seismic pre-approval for component Importance Factor 1.5

Application

The BPS provides additional power and circuits for notification appliances and other 24 Vdc loads. It is listed for indoor dry locations and can easily be installed where needed.

Fault conditions are indicated on the on-board diagnostic LEDs, opening the BPS input sense circuit and the trouble relay (if programmed). While this provides indication to the host system, the BPS can still be activated upon command. A separate AC Fail contact is available on the BPS circuit board, which can be programmed for trouble or AC Fail. There are seven on-board diagnostic LEDs: one for each NAC fault, one for battery fault, one for ground fault, and one for AC power.

The unique dual-input activation circuits of the BPS can be activated by any voltage from 6 to 45 VDC (filtered-regulated) or 11 to 33 Vdc (full-wave rectified, unfiltered). The first input circuit can be configured to activate 1-4 of the four possible outputs. The second input circuit can be configured to control circuits 3 and 4. When outputs are configured for auxiliary operation, these circuits can be configured to stay on or automatically deactivate 30 seconds after AC power is lost. This feature makes these circuits ideal for door holder applications. The BPS also has a separate 200 mA 24 Vdc output that can be used to power internal activation modules.

BPS NACs can be configured for a 3-3-3 temporal or continuous output. This makes the BPS ideal for applications requiring signaling rates that are not available from the main system.

In addition to the internally generated signal rates, the BPS can also be configured to follow the coded signal rate of the main system NACs. This allows for the seamless expansion of existing NACs.

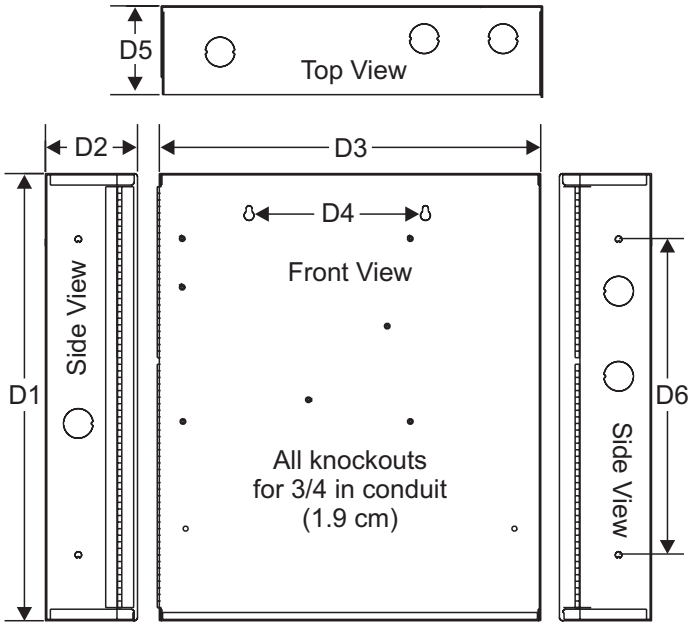
The BPS enclosure has mounting brackets for up to three Signature modules to the right of the circuit board.

Engineering Specification

Supply, where needed, EDWARDS BPS Series Booster Power Supplies (BPS) that are interconnected to and supervised by the main system. The BPS shall function as a stand-alone auxiliary power supply with its own fully-supervised battery compliment. The BPS battery compliment shall be sized to match the requirements of the main system. The BPS shall be capable of supervising and charging batteries having the capacity of 24 ampere-hours for Mass Notification/Emergency Communication (MNEC), life safety applications.

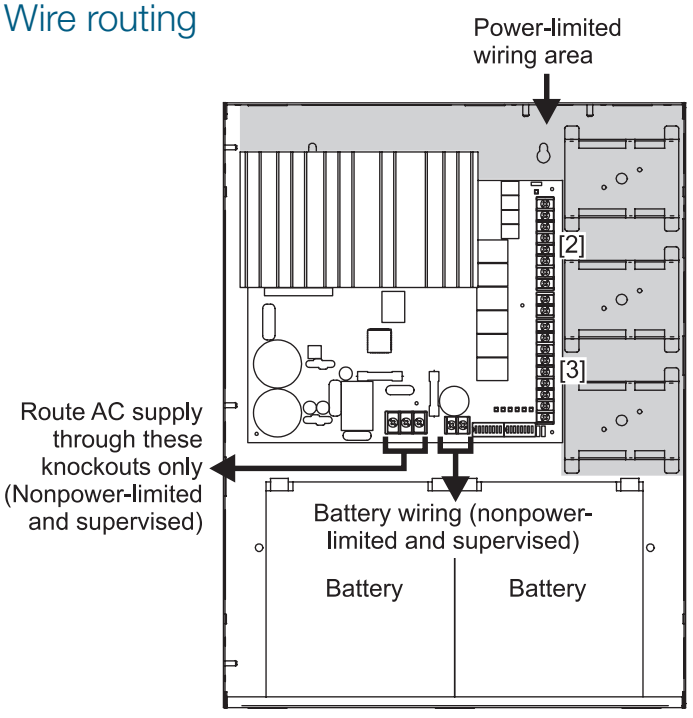
<<The BPS shall be capable of installation for a seismic component Importance Factor of 1.5.>> The BPS shall provide a minimum of four independent, fully supervised Class B circuits that can be field configurable for notification appliance circuits or auxiliary 24 Vdc power circuits. BPS NACs shall be convertible to a minimum of two Class A NACs. Each BPS output circuit shall be rated at 3 amperes at 24 Vdc. Each output circuit shall be provided with automatically restoring overcurrent protection. The BPS shall be operable from the main system NAC and/or EDWARDS Signature Series control modules. BPS NACs shall be configurable for continuous or 3-3-3 temporal rate. Fault conditions on the BPS shall not impede operation of main system NAC. The BPS shall be provided with ground fault detection circuitry and a separate AC fail relay.

Dimensions



D1	D2	D3	D4	D5	D6
17.0 in (43.2 cm)	3.5 in (8.9 cm)	13.0 in (33.0 cm)	6.5 in (16.5 cm)	3.375 in (8.6 cm)	12.0 in (30.4 cm)

Wire routing



Notes

1. Maintain 1/4-inch (6 mm) spacing between power-limited and nonpower-limited wiring or use type FPL, FPLR, or FPLP cable per NEC.

[2] Power-limited and supervised when not configured as auxiliary power. Non-supervised when configured as auxiliary power.

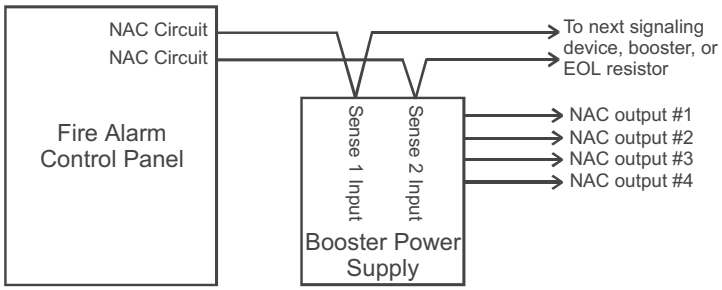
[3] Source must be power-limited. Source determines supervision.

4. When using larger batteries, make sure to position the battery terminals towards the door.

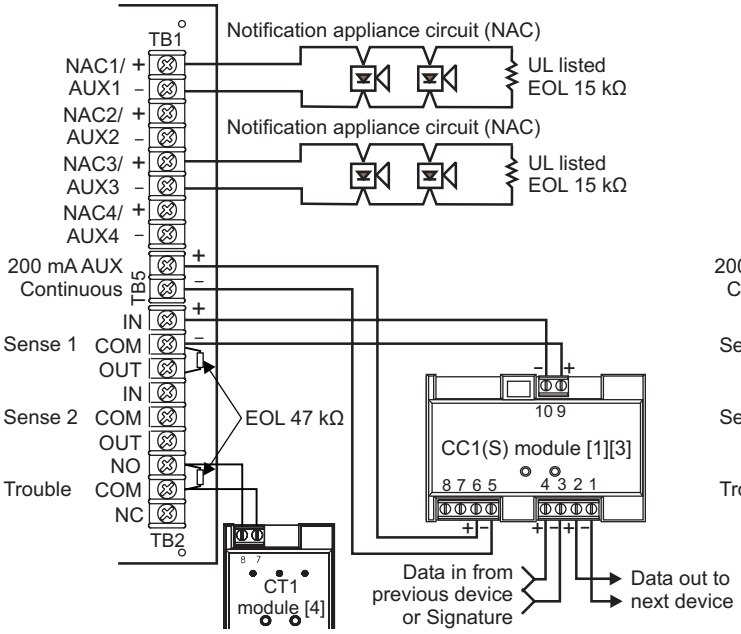
Typical Wiring

Single or cascaded booster anywhere on a notification appliance circuit

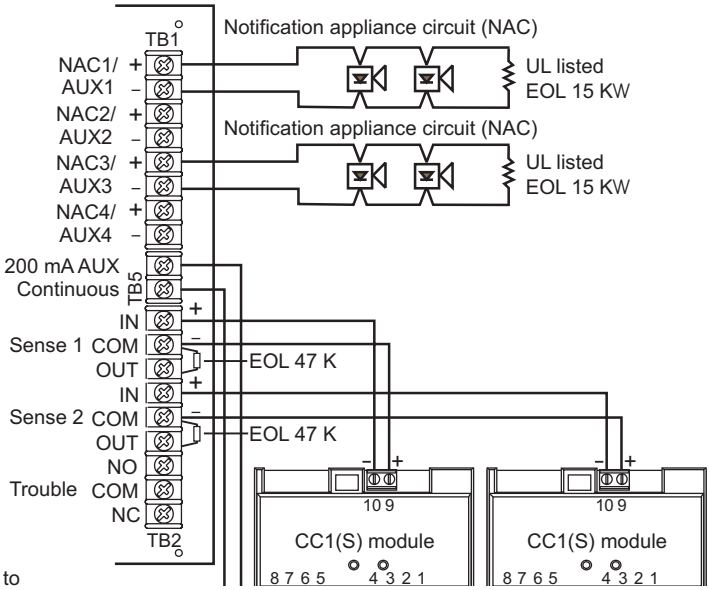
Existing NAC end-of-line resistors are not required to be installed at the booster's terminals. This allows multiple boosters to be driven from a single NAC circuit without the need for special configurations.



Configuring the Booster for AC Power Fail delay operation*



Multiple CC1(S) modules using the BPS's sense inputs



*The Booster supports AC Power fail delay of three hours via its trouble contact when dip switch SW2-6 is on. All other troubles are reported to supervising module or panel without delay via Sense inputs.

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

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Bradenton, FL 34202

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Specifications

Model	6.5 amp Booster	10 amp Booster
AC Line Voltage	120VAC or 220-240VAC 50/60Hz 390 watts	120VAC or 220-240VAC 50/60Hz 580 watts
Notification Appliance Circuit Ratings	3.0A max. per circuit @ 24Vdc nominal 6.5A max total all NACs	3.0A max. per circuit @ 24Vdc nominal 10A max total all NACs
Trouble Relay	2 Amps @ 30Vdc	
Auxiliary Outputs	Four configurable outputs replace NACs 1, 2, 3 or 4. as auxiliary outputs and 200 mA dedicated auxiliary. (See note 1.)	
Input Current (from an existing NAC)	3mA @ 12Vdc, 6mA @ 24Vdc	
Booster Internal Supervisory Current	70mA + 35 mA for each circuit set to AUX	
Booster Internal Alarm Current	270mA	
Signature Mounting Space	Accomodates three two-gang modules.	
Maximum Battery Size	10 Amp Hours (2 of 12V10A) in cabinet up to 24 Amp hours with external battery cabinet for fire applications.	
Terminal Wire Gauge	18-12 AWG	
Relative Humidity	0 to 93% non condensing @ 32°C	
Temperature Rating	32° to 120°F (0° to 49°C)	
NAC Wiring Styles	Class A or Class B	
Output Signal Rates	Continuous, 3-3-3 temporal, or follow installed panel's NAC.	
Ground Fault Detection	Enable or Disable via jumper	
Agency Listings	UL, ULC, CSFM	

1. Maximum of 8 Amps can be used for auxiliary output.

Ordering Information

Catalog Number	Description	Shipping Wt. lb (kg)
BPS6A	6.5 Amp Booster Power Supply	13 (5.9)
BPS6AC	6.5 Amp Booster Power Supply (ULC)	13 (5.9)
BPS6A/230	6.5 Amp Booster Power Supply (220V)	13 (5.9)
BPS10A	10 Amp Booster Power Supply	13 (5.9)
BPS10AC	10 Amp Booster Power Supply (ULC)	13 (5.9)
BPS10A/230	10 Amp Booster Power Supply (220V)	13 (5.9)
Related Equipment		
12V6A5	7.2 Amp Hour Battery, two required	3.4 (1.6)
12V10A	10 Amp Hour Battery, two required	9.5 (4.3)
3-TAMP	Tamper switch	
BPS-CVR	Electronics Protective Cover	
BC-1EQ	Seismic Kit for BC-1. Order BC-1 separately. See note 2	
BPSEQ	Seismic kit for BPS6A or BPS10 Booster Power Supplies. See note 2	
BC-1	Battery Cabinet (up to 2 - 40 Amp Hour Batteries)	58 (26.4)
BC-2	Battery Cabinet (up to 2 - 17 Amp Hour Batteries)	19 (8.6)
12V17A	18 Amp Hour Battery, two required (see note 1)	13 (5.9)
12V24A	24 Amp Hour Battery, two required (see note 1)	20 (9.07)

1. Requires installation of separate battery cabinet.
2. For earthquake anchorage, including detailed mounting weights and center of gravity detail, refer to Seismic Application Guide 3101676. Approval of panel anchorage to site structure may require local AHJ, structural or civil engineer review.

EDWARDS
Built for Resilience

ConnectedSafety+
Cellular Gateway Series

Remote Visibility. Real-time Efficiency.



Overview

ConnectedSafety+ is a secure, cloud-based platform that provides remote access to the EST4 fire system and connected Edwards devices to optimize efficiency and reliability, Enabled by the Edwards Cellular Gateway, ConnectedSafety+ delivers real-time system diagnostics, predictive maintenance, performance insights, and on-demand reporting - at anytime, from anywhere.

Standard Features

The CG1 series provides a set of core features unmatched in the industry:

- Installation and configuration of ConnectedSafety+ dual carrier communicator does not require access to your customers local network
- The Cellular Gateway automatically connects through the strongest available carrier – AT&T or Verizon – to maintain uninterrupted communication. This automatic carrier selection, with fail-over technology, provides a dependable, always-on connection for critical alerts
- Every unit is ready to go out of the box with simple configuration or can be fully customized. The pre-activated SIM card means faster onboarding. Plus, installation does not require access to your customer's local network
- With peak power consumption under 150mA, the lower power consumption by the Cellular Gateway allows more devices to be connected to the fire panel, reducing complexity and overall cost
- 5G LTE-M Technology for extended longevity - no LTE sunsets
- Universal Central Station delivery:
  - IP, XML
  - CID, SIA
- North American coverage in a single unit:
  - AT&T and Verizon in the US
  - Rogers, TELUS, Bell in Canada
- AC and DC power input
- Fire rated enclosure is included and suitable for any installation with conduits

Additional Features

ECG1-P

- Plastic enclosure is designed for panel-powered installations
- DC Powered (up to 30VDC)
- Cover screws down to enclosure

ECG1-M

- Metal enclosure is designed for AC-powered installations - can house it's own battery
- Unit comes with UL Listed power supply
- Connects to DC or AV power source
- Cover locks in place with provided secure key

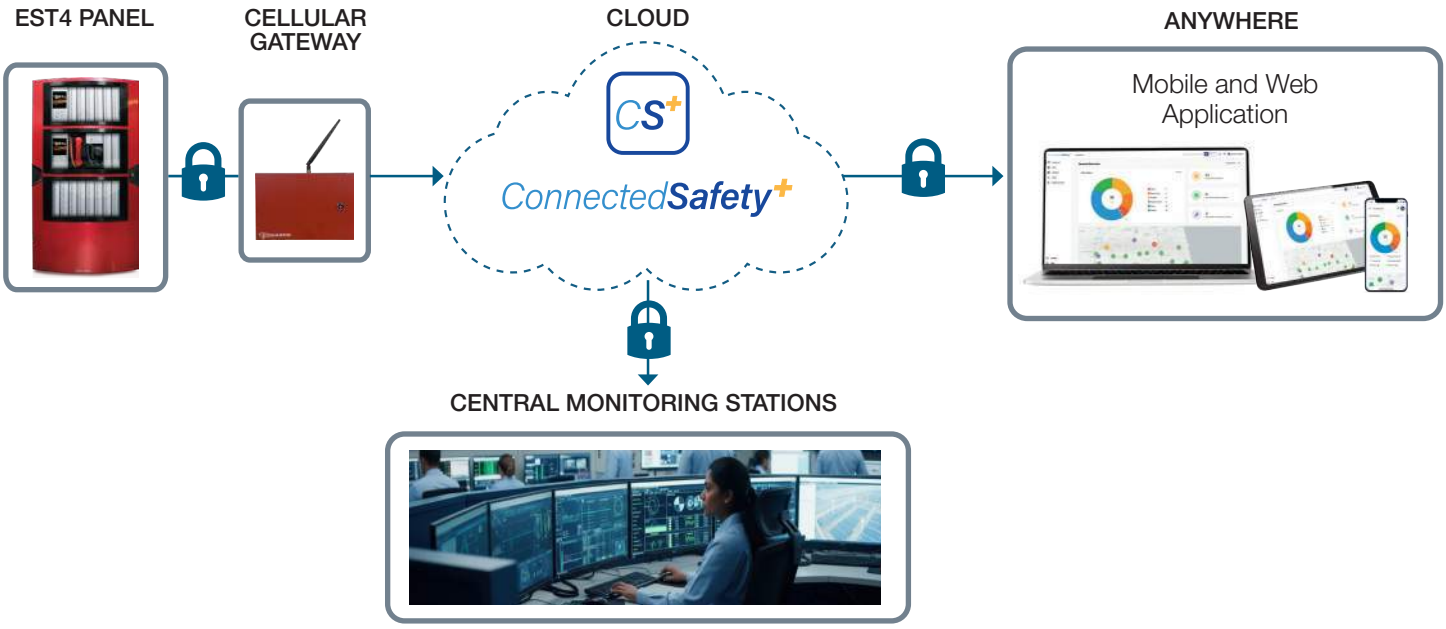
Accessories – (need to order separately - not included with cell gateway)

SKU	Description
72012101	9” replacement antenna for 5G LTE-M radios
TG-TAMPER	Tamper Switch Assembly compatible with FACP metal enclosures
ACD-12	12 feet - low loss high performance antenna cable and mounting bracket
ACD-35	35 feet - low loss high performance antenna cable and mounting bracket
ACD-50	50 feet - low loss high performance antenna cable and mounting bracket
ACD-100	100 feet - low loss high performance antenna cable and mounting bracket
HGDL-0	High Gain Directional Antenna
EXDL-0	External Omni-Directional Antenna
TG-PEM	Power Expansion module- (8 dry contact zones for reporting & provides 24 VDC from the panel)

Panels Supported

PANEL	CS+	CMS		HARDWARE NEEDED	LICENSES	REF DOCUMENTS
		IP DIALER	DIAL CAPTURE			
EST4	Yes	Yes	No	4-FWAL2/4, 4-FWAL-CAT and 4-BRKT-CS/CB	CSP-CG-CMBP	E85014-5001

Edwards ConnectedSafety+ Network



Contact us

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ACEBOX
BY SPACE AGE ELECTRONICS

SRD ACE-11

System Record Documents



Store important system documents in a secure location with a cabinet built specifically to meet the requirements of NFPA 72 7.7.2.4.

The number one goal at Space Age is to manufacture code compliant solutions, and the SRD is just that. NFPA 72 7.7.2.1 states, “With every new system, a documentation cabinet shall be installed at the system control unit or other approved location at the protected premises.”

The SRD includes our innovative 8GB flash drive slide tab that allows the user to select a USB-C or Micro USB connector to access records electronically (See NFPA 72 7.5.6.7).

FEATURES

- 18 gauge cold rolled steel construction with red powder coat and white lettering
- Dimensions are 12” wide x 13” tall and 2 1/4” deep
- Stainless steel piano hinge
- Two key ring hooks to hold system keys
- Business card holder for key contacts
- Slide tab allows user to select USB-C or Micro USB connector to download from 8GB digital flash memory
- DCD Computer Desk Kit (sold separately) holds enclosure door open at a 90 degree angle with a snap on cable for a convenient working surface in the field. Includes velcro strap for securing your laptop.

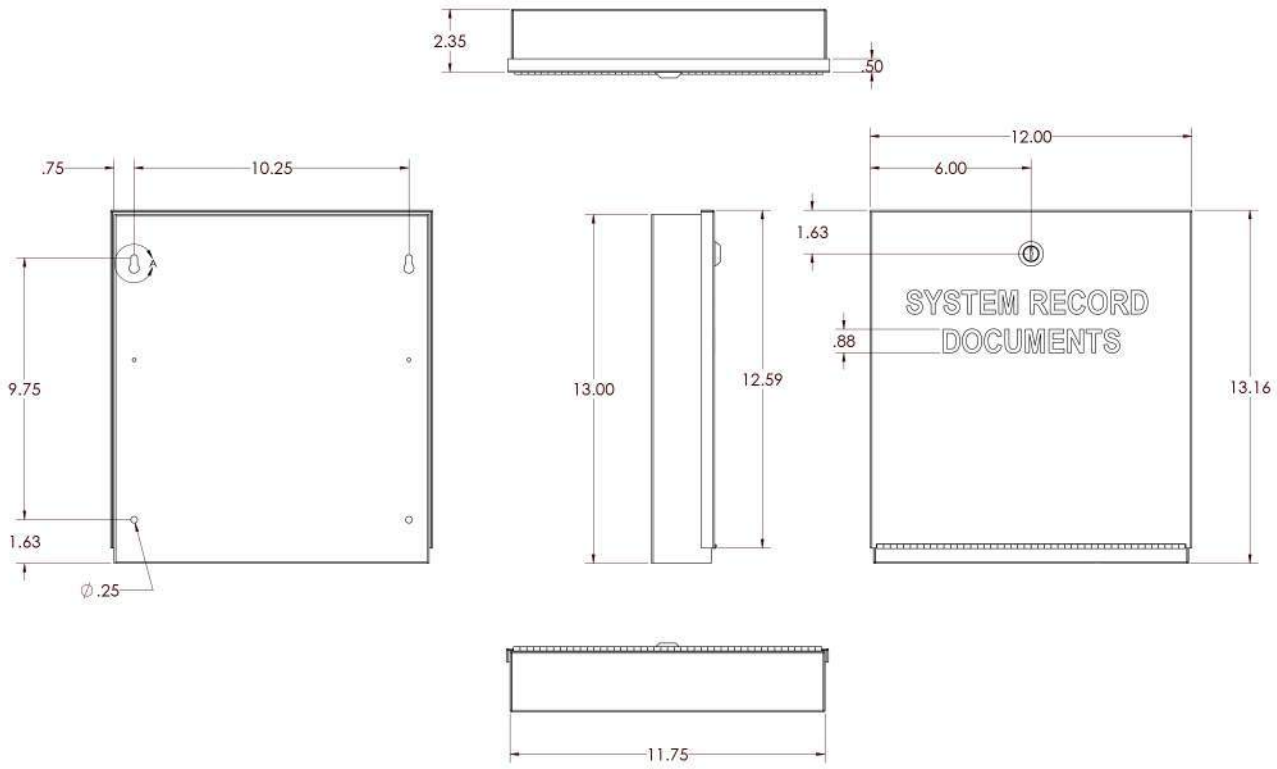
SPECIFICATIONS

The SRD System Record Documents Box shall be UL Listed, constructed of 18 gauge cold rolled steel. It shall have a powder coat finish. The cover shall be permanently screed with 1” high lettering “SYSTEM RECORD DOCUMENTS” with white indelible ink. The access door shall be locked with a 3/4” barrel lock and there will be a 12” stainless steel piano hinge. The SRD will have a minimum of 8 gigabyte digital flash memory drive with a slide tab that allows user to select USB-C or Micro USB connector for uploading and downloading information. The enclosure will supply 4 mounting holes. Inside will accommodate standard 8 1/2” x 11” manuals and document records. A legend sheet will be attached to the door for system required documentation, key contacts and system information. The enclosure shall also provide 2 key ring holders with a location to mount standard business cards for key contact personnel.

CUSTOM COLORS AND BRANDING AVAILABLE



DIMENSIONS



ORDERING INFORMATION

P/N# SSU00689
SRD System Record Documents Box - Red

P/N# SSU00690
SRD System Record Documents Box - Red with your custom screened logo

P/N# SSU01689
SRD System Record Documents Box - Black

P/N# SSU01690
SRD System Record Documents Box - Black with your custom screened logo

P/N# SSU00616
DCD Computer Desk Kit

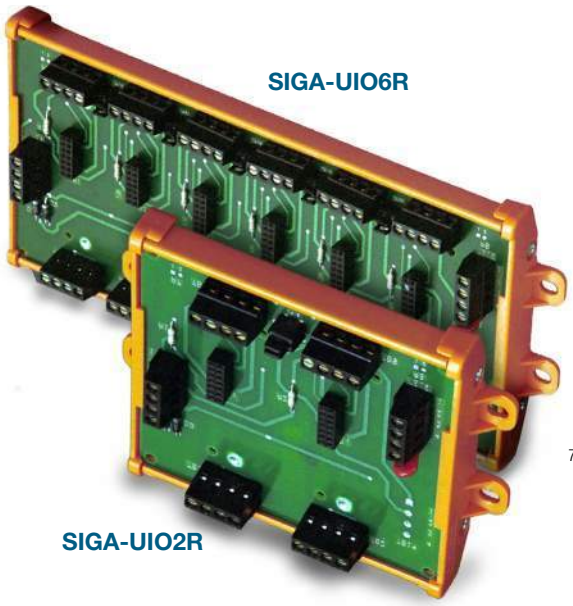
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EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Universal Input/ Output Module Motherboards

SIGA-UIO2R, SIGA-UIO6R,



FM APPROVED

7300-1657: 0121

S3424

Overview

Signature Series Universal Input-Output Module Motherboards provide mounting and wiring terminations for up to six Signature Series plug-in UIO (SIGA-"M" series) modules. UIO motherboards slide into a rigid extruded track (included) with mounting pads for convenient mounting into a variety of equipment enclosures. UIO modules plug into the board and are held securely in place with captive machine screws. All field wiring connects to terminal blocks on the motherboard, which permits rapid removal and replacement of modules for troubleshooting.

The **SIGA-UIO2R** provides mounting and wiring terminations for up to two UIO modules, and the **SIGA-UIO6R** provides mounting and wiring terminations for up to six UIO modules. Both motherboards feature a riser #1 input and a riser #2 input bus. Jumpers on riser #1 input, between modules, facilitate sharing a single riser among more than one module. This significantly reduces wiring requirements. Removing the jumpers provide separate riser inputs to each adjacent module. Riser #2 input is fixed to each module position and cannot be split.

The **SIGA-UIO6** provides mounting and wiring terminations for up to six UIO modules. This motherboard provides two riser inputs that are common to all modules.

Standard Features

- **Modular flexibility**
  Wide assortment of multi-function plug-in modules provides total flexibility.
- **Minimum wiring requirements**
  Integral jumpers between modules allow sharing of risers to reduce installation wiring.
- **Easy installation**
  #12 AWG (2.5 mm2) terminal blocks and sturdy mounting pads ensure quick installation into EDWARDS enclosures.
- **Supports automatic device mapping**
  All compatible UIO modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Supports intelligent devices**
  On-board modules make decisions and input an alarm from initiating devices connected to them even if the loop controller's polling interrogation stops.
- **Twisted or shielded wire not required**
  Because all decisions are made at the on-board modules, lower communication speeds are possible. This results in substantially improved control panel response time and less sensitivity to line noise and loop wiring properties.
- **Supports electronic addressing**
  Programmable addresses are downloaded to compatible UIO modules from the loop controller, a PC, or the SIGA-PRO Signature Program/Service Tool. There are no switches or dials to set.

Mounting and Installation

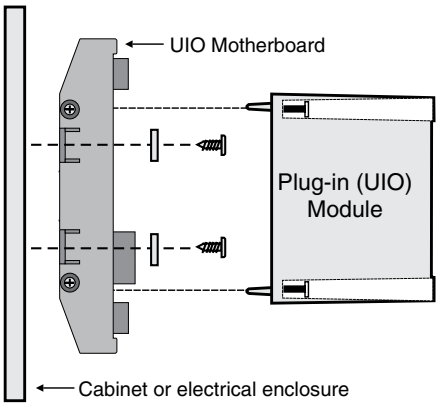
Mount the UIO motherboard inside a EDWARDS MFC-A cabinet or other suitable electrical enclosure with screws and washers provided. Each MFC-A will hold one UIO2R motherboard or one UIO6 or UIO6R motherboard complete with their full complement of modules.

Plug a Signature Series UIO module into any available position on the motherboard and secure the module to the motherboard with the captive screws. Wiring connections are made to the terminals on the motherboard (see wiring diagram). UIO motherboard terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.

EDWARDS recommends that all boards and modules be installed according to latest recognized edition of national and local fire alarm codes.



The MFC-A cabinet is UL listed for use with UIO motherboards and meets requirements for spacing and clearance around the components.



Testing & Maintenance

The module's automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each module and other pertinent messages. Single modules may be turned off (de-activated) temporarily, from the control panel.

Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

Compatibility

Signature Series Universal Input/Output Module Boards are compatible only with SIGA-"M" Series I/O Modules, which require a Signature Data Controller. They are compatible with EST3, EST3X and iO Series control panels.

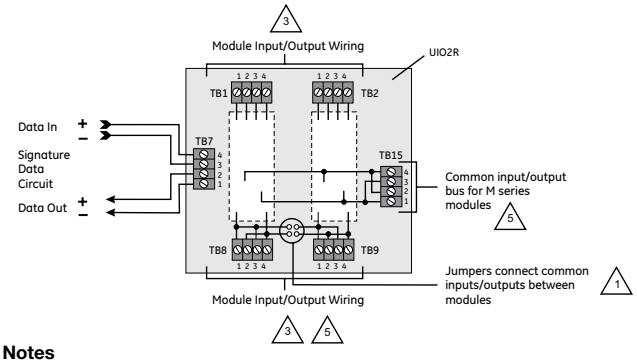
Warnings & Cautions

Signature devices will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your fire protection specialist.

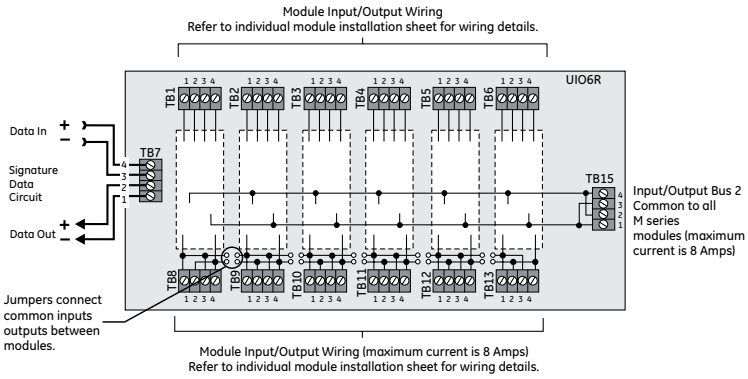
Typical Wiring

Signature Series Universal Input/Output Motherboards have terminal blocks to accept #18 AWG (0.75mm^2), #16 AWG (1.0mm^2), #14 AWG (1.5mm^2), and #12 AWG (2.5mm^2) wire sizes. See Signature Data Controller catalog sheets for detailed wiring requirements and specifications.

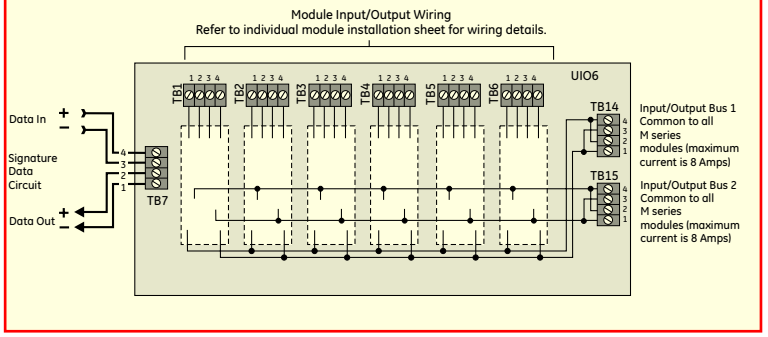
SIGA-UIO2R



SIGA-UIO6R



SIGA-UIO6



Notes

1. Jumpers may be used to make the inputs/outputs between modules common.
2. Not all modules use the SIGA-UIO2R terminals for the same functions.
3. Refer to individual SIGA-M series installation sheets for jumper settings and wiring information. Installations with multiple SIGA-UIO motherboards or enclosures (which include other wiring) require FPL, FPLR, FPLP, or equivalent NEC-approved wire for all power limited wiring. Observe the details of supervision and power limited versus non-power limited circuits. Refer to the SIGA-M series installation sheets.
4. Do not mix incompatible signals.
5. Maximum current is 8 Amps.
7. Refer to Signature Data Controller Installation Sheets for wiring specifications.

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Website: edwardsfiresafety.com

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Bradenton, FL 34202

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Specifications

Catalog Number	SIGA-UIO2R	SIGA-UIO6R	SIGA-UIO6
Module Capacity	Two	Six	Six
Dimensions (with module installed)	5.4 inch L (across mounting feet) x 4.3 inch W x 3.2 inch H	9.56 inch L (across mounting feet) x 4.3 inch W x 3.2 inch H	
Address Requirements	no address required		
Type Code	none		
Compatible Modules	All SIGA-Mxxx Signature Series		
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)		
Mounting (cabinets)	Directly into suitable enclosures (e.g.: MFC-A) - Notes 1, 2, 3.		
Wiring Terminals	#12 AWG (2.5mm²) to #18 AWG (0.75mm²)		
Storage and Operating Environment	Operating Temperature: 32°F to 120°F (0°C to 49°C) Storage Temperature: -4°F to 140°F (-20°C to 60°C) Operating and Storage Humidity: 0 to 93% RH		
Agency Listing	UL, ULC, MEA, CSFM		

Notes:

1. Allow a minimum clearance of one inch around all sides of the UIO motherboard.
2. On-site drilling of mounting holes may be required. Self-tapping mounting screws are provided.
3. Suitable cabinets: MFC-A, CAB2, 3-CAB5, 3-CAB7, 3-CAB14, 3-CAB21, 3-RCC series, RACC series.

Ordering Information

Catalog Number	Description	Ship Wt. - lb (kg)
SIGA-UIO2R	Universal Input-Output Module Board w/Riser Inputs - Two Module Positions	0.32 (0.15)
SIGA-UIO6R	Universal Input-Output Module Board w/Riser Inputs - Six Module Positions	0.62 (0.28)
SIGA-UIO6	Universal Input-Output Module Board - Six Module Positions	0.56 (0.25)
MFC-A	UL listed cabinet for mounting UIO motherboards, red with white “FIRE” 8 inch H X 14 inch W X 3.5 inch D (203 mmH X 356 mm W X 89 mm D)	7.0 (3.1)

LIFE SAFETY & INCIDENT MANAGEMENT

Manual Pull Stations

SIGA-270, SIGA-270P, SIGA-278



SIGA-270 SERIES

SIGA-278

Patented

MEA FM APPROVED 7150-1657: 0129 S2318

Overview

The SIGA-270 and SIGA-278 series Manual Pull Stations are part of EDWARDS's Signature Series system. The SIGA-270 Fire Alarm Manual Pull Stations feature our very familiar teardrop shape. They are made from die-cast zinc and finished with red epoxy powder-coat paint complemented by aluminum colored stripes and markings. With positive pull-lever operation, one pull on the station handle breaks the glass rod and turns in a positive alarm, ensuring protection plus fool-proof operation. Presignal models (SIGA-270P) are equipped with a general alarm (GA) keyswitch for applications where two stage operation is required. The up-front highly visible glass rod discourages tampering, but is not required for proper operation.

EDWARDS's double action single stage SIGA-278 station is a contemporary style manual station made from durable red colored lexan. To initiate an alarm, first lift the upper door marked "LIFT THEN PULL HANDLE", then pull the alarm handle.

Standard Features

Note: *Some features described here may not be supported by all control systems. Check your control panel's Installation and Operation Guide for details.*

- **Traditional familiar appearance**
  SIGA-270 models feature our familiar teardrop design with simple positive pull action and sturdy die-cast metal body.
- **One stage (GA), two stage (pre-signal), and double action models**
  SIGA-270 models are available for one or two stage alarm systems. The single stage double action SIGA-278 features a rugged Lexan housing with keyed reset mechanism.
- **Break glass operation**
  An up-front visible glass rod on the SIGA-270 discourages tampering.
- **Intelligent device with integral microprocessor**
  All decisions are made at the station allowing lower communication speed while substantially improving control panel response time. Less sensitive to line noise and loop wiring properties; twisted or shielded wire is not required.
- **ADA Compliant**
  Meets ADA requirements for manual pull stations.
- **Electronic Addressing with Non-volatile memory**
  Permanently stores programmable address, serial number, type of device, and job number. Automatically updates historic information including hours of operation, last maintenance date, number of alarms and troubles, and time and date of last alarm.
- **Automatic device mapping**
  Each station transmits wiring information to the loop controller regarding its location with respect to other devices on the circuit.
- **Diagnostic LEDs**
  Status LEDs; flashing GREEN shows normal polling; flashing RED shows alarm state.
- **Designed for high ambient temperature operation**
  Install in ambient temperatures up to 120 °F (49 °C).

Application

The operating characteristics of the fire alarm stations are determined by their sub-type code or “Personality Code”. NORMALLY-OPEN ALARM - LATCHING (Pesonality Code 1**)** is assigned by the factory; no user configuration is required. The device is configured for Class B IDC operation. An ALARM signal is sent to the loop controller when the station’s pull lever is operated. The alarm condition is latched at the station.

Compatibility

Signature Series manual stations are compatible only with EDWARDS’s Signature Loop Controller.

Warnings & Cautions

This device will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your local fire protection specialist.

Testing & Maintenance

To test (or reset) the station simply open the station and operate the exposed switch. The SIGA-270 series are opened with a tool; the SIGA-278 requires the key which is supplied with that station.

The station’s automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each Signature series device and other pertinent messages. Single devices may be deactivated temporarily, from the control panel. Availability of maintenance features is dependent on the fire alarm system used.

Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

Typical Wiring

The fire alarm station’s terminal block accepts #18 AWG (0.75mm^2) to #12 AWG (2.5mm^2) wire sizes. See Signature Loop Controller catalog sheet for detailed wiring requirement specifications.

Wiring Notes

1. Refer to Signature Loop Controller manual for maximum wire distance.
2. All wiring is power limited and supervised.

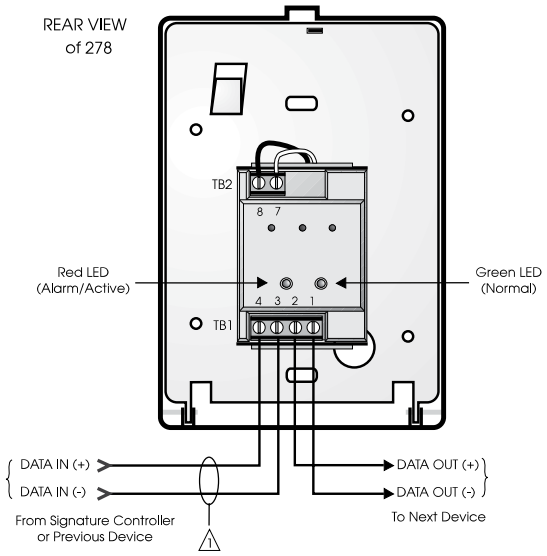


Figure 4. Single Stage Systems

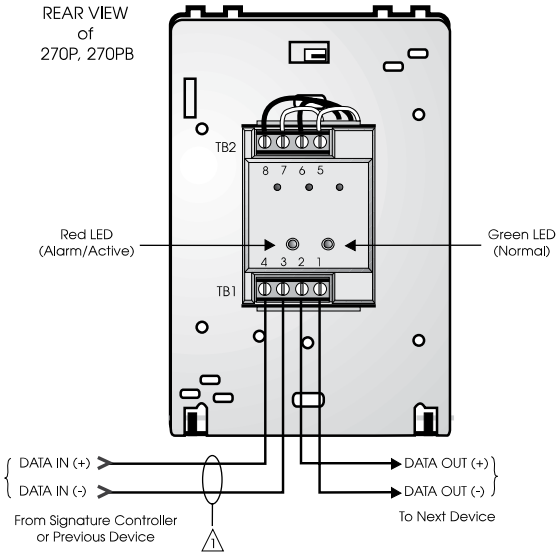


Figure 5. Two Stage Systems

Installation

Single-stage Signature Series fire alarm manual pull stations mount to North American 2½ inch (64 mm) deep 1-gang boxes.

Two stage presignal (270P) models require 1½ inch (38 mm) deep 4-inch square boxes with 1-gang, ½-inch raised covers. Openings must be angular. *Rounded openings are not acceptable.* Recommended box: Steel City Model 52-C-13; in Canada, use Iberville Model CI-52-C-49-1/2.

All models include terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size. EDWARDS recommends that these fire alarm stations be installed according to latest recognized edition of national and local fire alarm codes.

Electronic Addressing: The loop controller electronically addresses each manual station, saving valuable time during system commissioning. Setting complicated switches or dials is not required. Each station has its own unique serial number stored in its on-board memory. The loop controller identifies each device on the loop and assigns a "soft" address to each serial number. If desired, the stations can be addressed using the SIGA-PRO Signature Program/Service Tool.

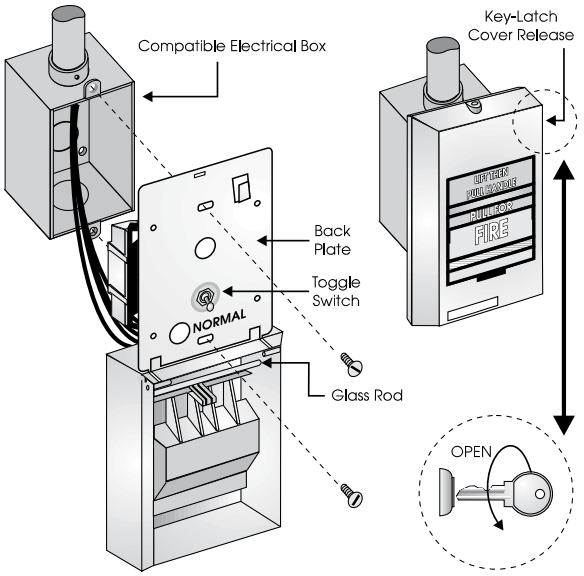


Figure 1. SIGA-278 installation

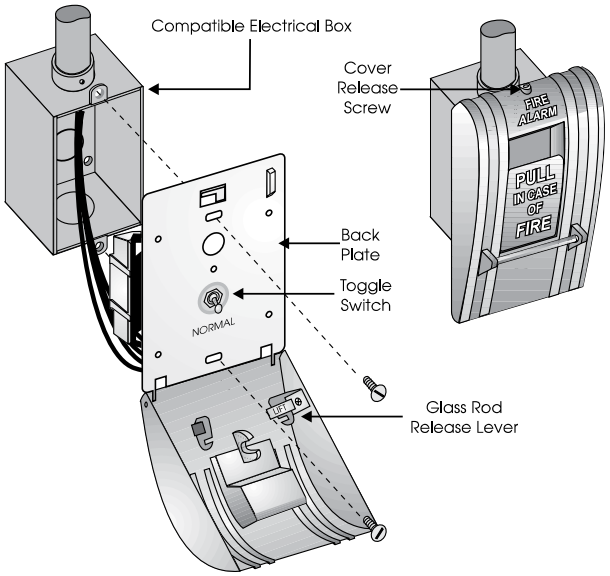


Figure 2. SIGA-270, SIGC-270F, SIGC-270B installation

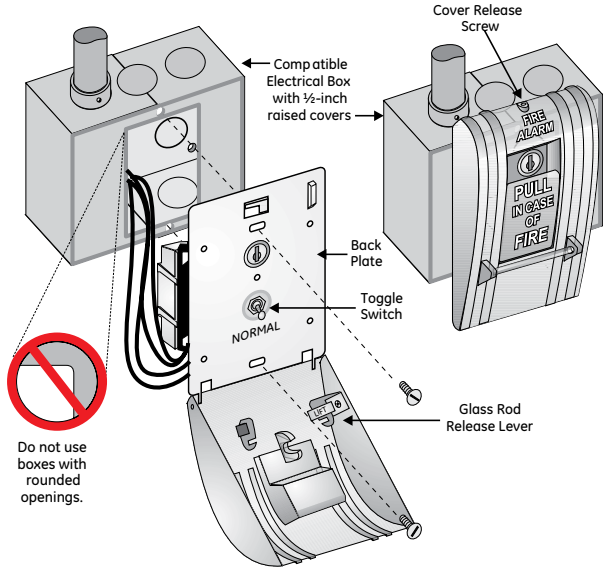


Figure 3. SIGA-270P, SIGC-270PB installation

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Contact us

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Bradenton, FL 34202

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Specifications

Catalog Number	SIGA-270, SIGC-270F, SIGC-270B	SIGA-270P, SIGC-270PB	SIGA-278
Description	Single Action - One Stage	Single Action -Two Stage (Presignal)	Double Action - One Stage
Addressing Requirements	Uses 1 Module Address	Uses 2 Module Addresses	Uses 1 Module Address
Operating Current	Standby = 250µA Activated = 400µA	Standby = 396µA Activated = 680µA	Standby = 250µA Activated = 400µA
Construction & Finish	Diecast Zinc - Red Epoxy with aluminum markings		Lexan - Red with white markings
Type Code	Factory Set		
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)		
Storage and Operating Environment	Operating Temperature: 32ºF to 120ºF (0ºC to 49ºC) Storage Temperature: -4ºF to 140ºF (-20ºC to 60ºC) Humidity: 0 to 93% RH		
LED Operation	On-board Green LED - Flashes when polled On-board Red LED - Flashes w hen in alarm		
Compatibility	Use With: Signature Loop Controller		
Agency Listings	UL, ULC (note 1), MEA, CSFM, FM		

Note: *SIGC-270F, SIGC-270B and SIGC-270PB are ULC listed only. Suffix "F" indicates French markings. Suffix "B" indicates English/French biling ual markings.*

Ordering Information

Catalog Number	Description	Ship Wt. lbs (kg)
SIGA-270	One Stage Fire Alarm Station, English Markings - UL/ULC Listed	1 (0.5)
SIGC-270F	One Stage Fire Alarm Station, French Markings - ULC Listed	
SIGC-270B	One Stage Fire Alarm Station, French/English Markings - ULC Listed	
SIGA-270P	Two Stage (Presignal) Fire Alarm Station, English Markings - UL/ULC Listed	
SIGC-270PB	Two Stage (Presignal) Fire Alarm Station, French/English Markings - ULC Listed	
SIGA-278	Double Action (One Stage) Fire Alarm Station, English Markings - UL/ULC Listed	

Accessories		
32997	GA Key w/Tag - for pre-signal station (CANADA ONLY)	0.1 (.05)
276-K2	GA Key - for pre-signal station (USA ONLY)	
276-K1	Station Reset Key, Supplied with all Key Reset Stations	
27165	12 Glass Rods - for SIGA-270 series (CANADA ONLY)	
270-GLR	20 Glass Rods - for SIGA-270 series (USA ONLY)	
276-GLR	20 Glass Rods - for SIGA-278 series	
276B-RSB	Surface Mount Box, Red - for SIGA pull stations	1 (0.6)

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Synchronization Output Module

SIGA-CC1S, MCC1S



Patented

FM APPROVED MEA 7300-1657: 0121 S3424

Overview

SIGA-CC1S and MCC1S Synchronization Output Modules are intelligent analog addressable devices that form part of EDWARDS's Signature line of products. The actual operation of the SIGA-CC1S and MCC1S is determined by the "personality code" selected by the installer, which is downloaded to the module from the Signature loop controller during system configuration.

Depending on their assigned personality, Synchronization Output Modules may be used as a signal power riser selector to provide synchronization of fire alarm signals across multiple zones, or for connecting, upon command from the loop controller, supervised Class B signal or telephone circuits to their respective power inputs. The power inputs may be polarized 24 Vdc to operate audible and visible signal appliances or 25 and 70 VRMS to operate audio evacuation speakers and firefighter's telephones.

Standard Features

- **Provides UL 1971-compliant auto-sync output for visual signals**
  Use for connecting a supervised output circuit to a supervised 24 Vdc riser input and synchronizing multiple notification appliance circuits.
- **Functions as an audible signal riser selector**
  Use as a synch module or for connecting supervised 24 Vdc Audible/Visible signal circuits, or 25 and 70 VRMS Audio Evacuation and Telephone circuits to their power inputs.
- **Built-in ring-tone generator**
  When configured for telephone circuits, the SIGA-CC1S generates its own ring-tone signal, eliminating the need for a separate ring-tone circuit.
- **Automatic device mapping**
  Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Electronic addressing**
  Programmable addresses are downloaded from the loop controller, a PC, or the SIGA-PRO Signature Program/Service Tool; there are no switches or dials to set.
- **Intelligent device with microprocessor**
  All decisions are made at the module to allow lower communication speed with substantially improved control panel response time and less sensitivity to line noise and loop wiring properties; twisted or shielded wire is not required.

Application

The SIGA-CC1S mounts to a standard North American two-gang electrical box, making it ideal for locations where only one module is required. Separate I/O and data loop connections are made to each module.

The SIGA-MCC1S is part of the UIO family of plug-in Signature Series modules. It functions identically to the SIGA-CC1S, but takes advantage of the modular flexibility and easy installation that characterize all UIO modules. Two- and six-module UIO motherboards are available. These can accommodate individual risers for each on-board module, or risers that are shared by any combination of its UIO modules. All wiring connections are made to terminal blocks on the motherboard. UIO assemblies may be mounted in EDWARDS enclosures.

Personality Codes

The operation of the SIGA-CC1S is determined by their sub-type code or "Personality Code". The code is selected by the installer depending upon the desired application and is downloaded from the loop controller.

Personality Code 5: Signal Power or Audio Evacuation (single riser). Configures the module for use as a Class B Audible/Visible Signal power (24 Vdc polarized) or Audio Evacuation (25 or 70 VRMS) power selector. The ring-tone generator is disabled. The output circuit is monitored for open or shorted wiring. If a short exists, the control panel inhibits the activation of the audible/visible signal circuit to prevent connection to the power circuit.

Personality Code 6: Telephone with ring-tone (single riser). Configures the module for use as a Telephone power selector. When a telephone handset is plugged into its jack or lifted from its hook, the module generates its own Ring-Tone signal. A separate ring-tone circuit is not needed. The module sends this signal to the control panel to indicate that an off-hook condition is present. When the system operator responds to the call, the ring-tone signal is disabled.

Personality Code 25: Visual Signal Synchronization. This personality code configures the module to provide synchronization of fire alarm signals across multiple zones. It functions as a signal power (24 Vdc) riser selector. The output wiring is monitored for open circuits and short circuits. A short circuit will cause the fire alarm control panel to inhibit the activation of the audible/visual signal circuit so the riser is not connected to the wiring fault.

Warnings & Cautions

This module will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your fire protection specialist.

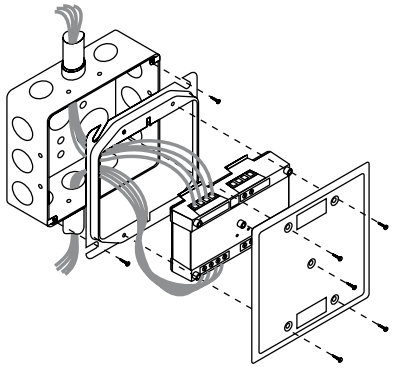
EDWARDS recommends that these modules be installed according to latest recognized edition of national and local fire alarm codes.

Compatibility

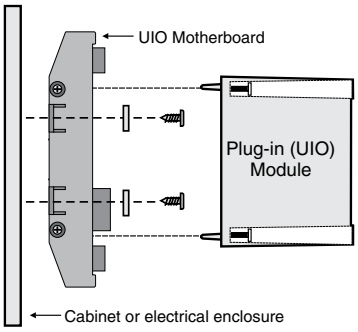
These modules are part of EDWARDS's Signature Series intelligent processing and control platform. They are compatible with EST3, EST3X and iO Series control panels.

Installation

The SIGA-CC1S: mounts to North American 2-1/2 inch (64 mm) deep 2-gang boxes and 1-1/2 inch (38 mm) deep 4 inch square boxes with 2-gang covers and SIGA-MP mounting plates. The terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



SIGA-MCC1S: mount the UIOxR motherboard inside a suitable EDWARDS enclosure with screws and washers provided. Plug the module into any available position on the motherboard and secure the module to the motherboard with the captive screws. Wiring connections are made to the terminals on the motherboard (see wiring diagram). UIOxR motherboard terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



Electronic Addressing

The loop controller electronically addresses each module saving valuable time during system commissioning. Setting complicated switches or dials is not required. Each module has its own unique serial number stored in its "on-board memory". The loop controller identifies each device on the loop and assigns a "soft" address to each serial number. If desired, the modules can be addressed using the SIGA-PRO Signature Program/Service Tool.

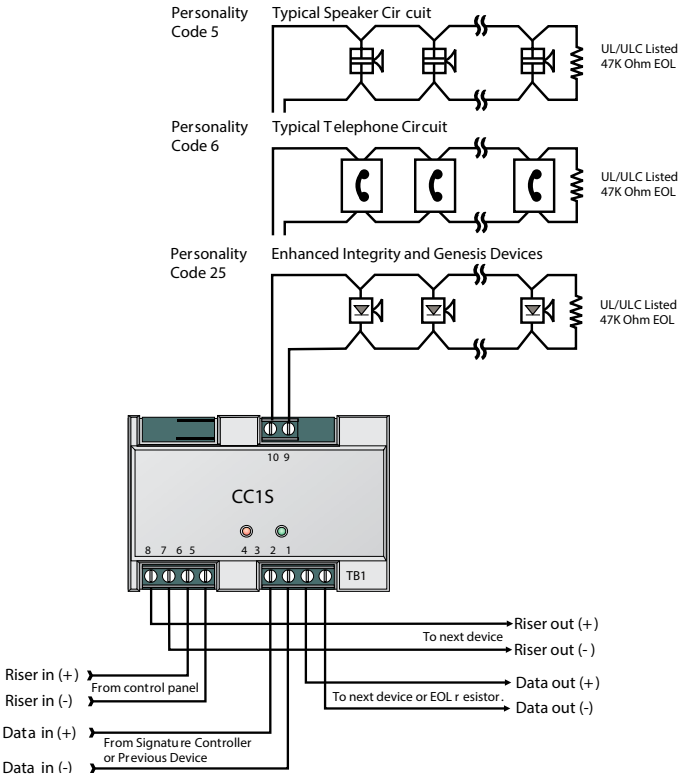
Testing & Maintenance

The module's automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each module and other pertinent messages. Single modules may be turned off (de-activated) temporarily, from the control panel.

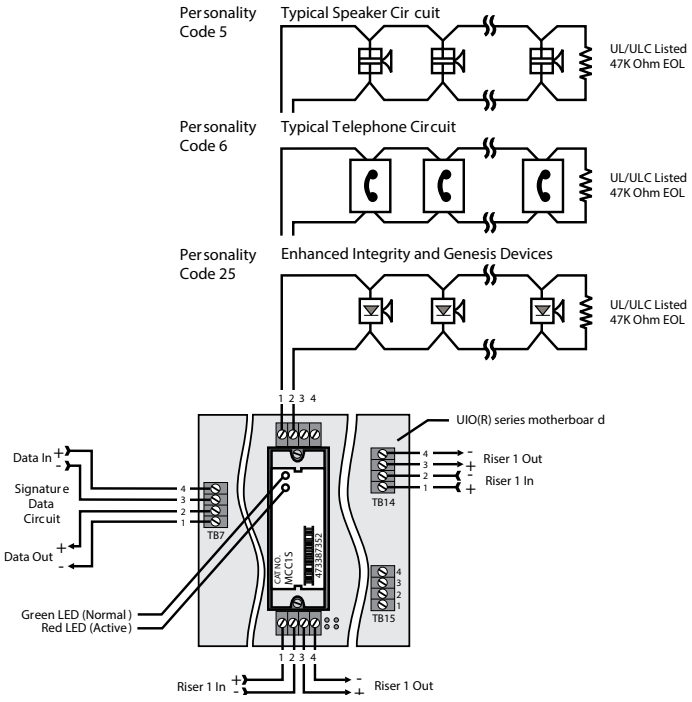
Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

Typical Wiring

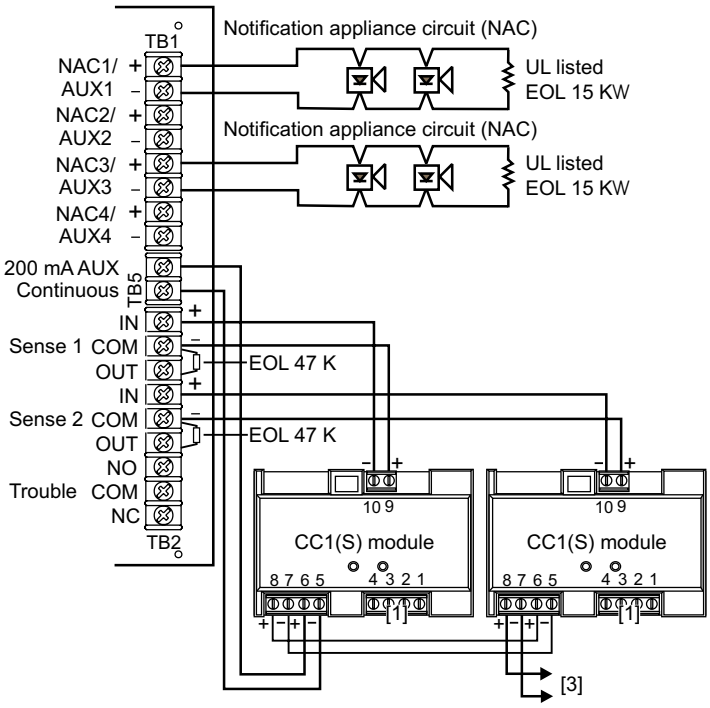
SIGA-CC1S (Standard Mount)



SIGA-MCC1S (UIO Mount)



Multiple CC1(S) modules using the BPS's sense inputs



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Specifications

Catalog Number	SIGA-CC1S	SIGA-MCC1S
Mounting	North American 2½ inch (64 mm) deep two-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 2-gang covers and SIGA-MP mounting plates	Plugs into UIO2R, UIO6R or UIO6 Motherboards
Description	Synchronization Output Module	
Type Code	50 (factory set)	
Address Requirements	Uses one module address	
Wiring Terminations	Suitable for #12 to #18 AWG (2.5 mm^2 to 0.75mm^2)	
Operating Current	Standby = 223µA Activated = 100µA	
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)	
Output Rating	24 Vdc = 2 amps 25 V Audio = 50 watts 70 V Audio = 35 watts	
Construction	High Impact Engineering Polymer	
Storage and Operating Environment	Operating: 32°F to 120°F (0°C to 49°C) Storage: -4°F to 140°F (-20°C to 60°C) Humidity: 0 to 93% RH	
LED Operation	Green LED - Flashes when polled Red LED - Flashes when in alarm/ active	
Compatibility	Use with: Signature Loop Controller under EST3 version 2.0 or higher	
Agency Listings	UL, ULC, CSFM, MEA	

Ordering Information

Catalog Number	Description	Shipping Wt. lbs (kg)
SIGA-CC1S	Synchronization Output Module (Standard Mount) - UL/ULC Listed	0.5 (0.23)
SIGA-MCC1S	Synchronization Output Module (UIO Mount) - UL/ULC Listed	0.18 (0.08)

Related Equipment		
27193-21	Surface Mount Box - Red, 2-gang	2 (1.2)
27193-26	Surface Mount Box - White, 2-gang	2 (1.2)
SIGA-UIO2R	Universal Input-Output Module Board w/Riser Inputs - Two Module Positions	0.32 (0.15)
SIGA-UIO6R	Universal Input-Output Module Board w/Riser Inputs - Six Module Positions	0.62 (0.28)
SIGA-UIO6	Universal Input-Output Module Board - Six Module Positions	0.56 (0.25)
235196P	Bi-polar Transient Protector	0.01 (0.05)
MFC-A	Multifunction Fire Cabinet - Red, supports Signature Module Mounting Plates	7.0 (3.1)
SIGA-MP1	Signature Module Mounting Plate, 1 footprint	1.5 (0.70)
SIGA-MP2	Signature Module Mounting Plate, 1/2 footprint	0.5 (0.23)
SIGA-MP2L	Signature Module Mounting Plate, 1/2 extended footprint	1.02 (0.46)

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Signal Modules

SIGA-CC1, SIGA-MCC1, SIGA-CC2 & SIGA-MCC2



SIGA-MCC



SIGA-CC

FM APPROVED MEA 7300-1657: 0121 S3424

Overview

SIGA-CC1/MCC1 Single Input Signal Modules and SIGA-CC2/MCC2 Dual Input Signal Modules are part of EDWARDS's Signature Series system. They are intelligent analog addressable devices used for connecting, upon command from the loop controller, supervised Class B signal or telephone circuits to their respective power inputs. The power inputs may be polarized 24 Vdc to operate audible and visible signal appliances or 25 and 70 VRMS to operate audio evacuation speakers and firefighter's telephones.

The actual operation of the SIGA-CC1/MCC1 and SIGA-CC2/MCC2 is determined by the "personality code" selected by the installer. It is downloaded to the module from the Signature loop controller during system configuration.

The SIGA-CC1 and SIGA-CC2 mount to standard North American two-gang electrical boxes, making them ideal for locations where only one module is required. Separate I/O and data loop connections are made to each module.

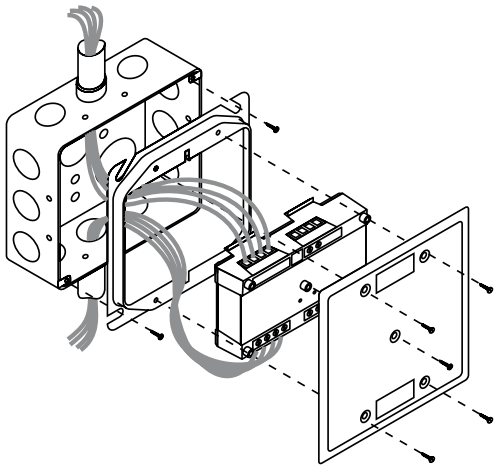
The SIGA-MCC1 and SIGA-MCC2 are part of the UIO family of plug-in Signature Series modules. They function identically to the SIGA-CC1 and SIGA-CC2, but take advantage of the modular flexibility and easy installation that characterize all UIO modules. Two- and six-module UIO motherboards are available. These can accommodate individual risers for each on-board module, or risers that are shared by any combination of its UIO modules. All wiring connections are made to terminal blocks on the motherboard. UIO assemblies may be mounted in EDWARDS enclosures.

Standard Features

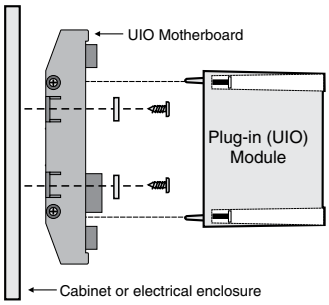
- **Single and Dual input (riser) select**
  Use for connecting supervised 24 Vdc Audible/Visible signal circuits, or 25 and 70 VRMS Audio Evacuation and Telephone circuits to their power inputs.
- **Ring-tone generator**
  When configured for telephone circuits, the SIGA-CC1 generates its own ring-tone signal eliminating the need for a separate ring-tone circuit.
- **Plug-in (UIO) or standard 2-gang mount**
  UIO versions allow quick installation where multiple modules are required. The 2-gang mount version is ideal for remote locations that require a single module.
- **Automatic device mapping**
  Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Electronic addressing**
  Programmable addresses are downloaded from the loop controller, a PC, or the SIGA-PRO Signature Program/Service Tool; there are no switches or dials to set.
- **Intelligent device with microprocessor**
  All decisions are made at the module to allow lower communication speed with substantially improved control panel response time and less sensitivity to line noise and loop wiring properties; twisted or shielded wire is not required.
- **Ground fault detection by address**
  Detects ground faults right down to the device level.

Installation

The SIGA-CC1 and SIGA-CC2: mount to North American 2-1/2 inch (64 mm) deep two-gang boxes and 1-1/2 inch (38 mm) deep 4-inch square boxes with two-gang covers and SIGA-MP mounting plates. The terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



SIGA-MCC1 and SIGA-MCC2: mount the UIO motherboard inside a suitable EDWARDS enclosure with screws and washers provided. Plug the SIGA-MCC1 or SIGA-MCC2 into any available position on the motherboard and secure the module to the motherboard with the captive screws. Wiring connections are made to the terminals on the motherboard (see wiring diagram). UIO motherboard terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



EDWARDS recommends that this module be installed according to latest recognized edition of national and local fire alarm codes.

Electronic Addressing - The loop controller electronically addresses each module saving valuable time during system commissioning. Setting complicated switches or dials is not required. Each module has its own unique serial number stored in its on-board memory. The loop controller identifies each device on the loop and assigns a "soft" address to each serial number. If desired, the modules can be addressed using the SIGA-PRO Signature Program/Service Tool.

Personality Codes 5 and 6 apply to the SIGA-CC1/MCC1 only and are assigned by the installer. Code 7 applies to the SIGA-CC2/MCC2 only. It is factory assigned; no user configuration is required.

Application

The operation of the SIGA-CC1/MCC1 and SIGA-CC2/MCC2 is determined by their sub-type code or "Personality Code". The code is selected by the installer depending upon the desired application and is down-loaded from the loop controller. Codes 5 and 6 apply to the SIGA-CC1/MCC1 only. Code 7 is assigned to the SIGA-CC2/MCC2 only and automatically applies to both circuits (A and B).

Personality Code 5: SIGNAL POWER or AUDIO EVACUATION (SINGLE RISER). Valid for the SIGA-CC1/MCC1 only. Configures the module for use as a Class B Audible/Visible Signal power (24 Vdc polarized) or Audio Evacuation (25 or 70 VRMS) power selector. The ring-tone generator is disabled. The output circuit is monitored for open or shorted wiring. If a short exists, the control panel inhibits the activation of the audible/visible signal circuit to prevent connection to the power circuit.

Personality Code 6: TELEPHONE w/RING-TONE (SINGLE RISER). Valid for the SIGA-CC1/MCC1 only. Configures the module for use as a Telephone power selector. When a telephone handset is plugged into its jack or lifted from its hook, the module generates its own Ring-Tone signal. A separate ring-tone circuit is not needed. The module sends this signal to the control panel to indicate that an off-hook condition is present. When the system operator responds to the call, the ring-tone signal is disabled.

Personality Code 7: SIGNAL POWER or AUDIO EVACUATION (DUAL RISER). Valid for the SIGA-CC2/MCC2 only. Configures the module for use as a two circuit Class B Audible/Visible Signal power (24 Vdc polarized) or Audio Evacuation (25 or 70 VRMS) power selector. The single output circuit is monitored for open or shorted wiring. If a short exists, the control panel inhibits the activation of the audible/visible signal circuit to prevent connection to the power circuit.

Warnings & Cautions

This module will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your fire protection specialist.

Compatibility

The Signature Series modules are compatible only with EDWARDS's Signature Loop Controller.

Testing & Maintenance

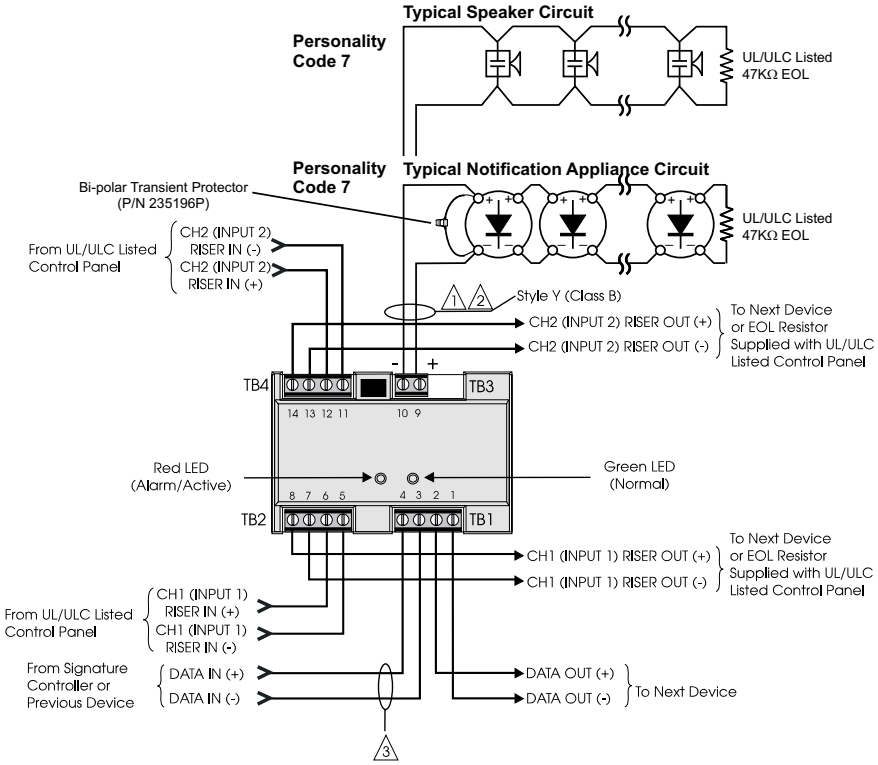
The module's automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each module and other pertinent messages. Single modules may be turned off (de-activated) temporarily, from the control panel.

Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

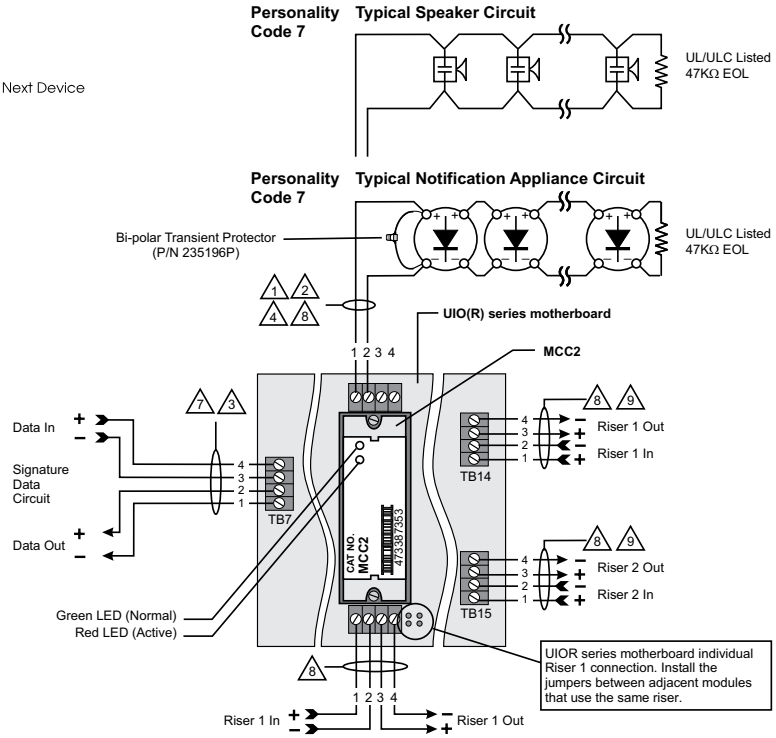
Typical Wiring (SIGA-CC2/MCC2)

Modules will accept #18 AWG (0.75mm²), #16 (1.0mm²), #14 AWG (1.50mm²) and #12 AWG (2.5mm²) wire sizes.

Note: Sizes #16 AWG (1.0mm²) and #18 AWG (0.75mm²) are preferred for ease of installation. See Signature Loop Controller catalog sheet for detailed wiring requirement specifications.



SIGA-CC2



SIGA-MCC2

Notes

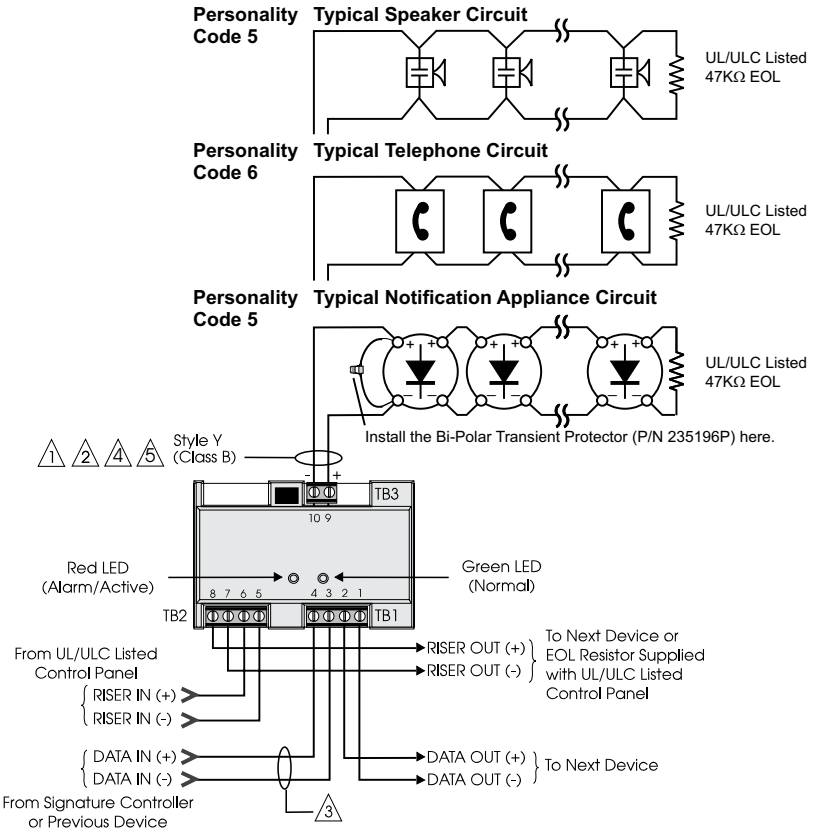
1. For maximum wire resistance and maximum wire distances, refer to IOMC Manual (P/N 270144).
2. Maximum #12 AWG (2.5mm²) wire. Min. #18 (0.75mm²).
3. Refer to Signature Loop Controller Installation Sheet for wiring specifications.
4. These modules will NOT support two-wire smoke detectors.
5. All wiring power limited and supervised. If the input source is non-power limited, then maintain spacing of 1/4 inch or use FPL, FPLP, FPLR or equivalent in accordance with NEC.
6. The SIGA-UIO6 does not come with TB8 through TB13.
7. Supervised and power-limited.
8. Supervised and power-limited when connected to a power-limited source. If the source is nonpower-limited, maintain a space of 1/4 inch from power-limited wiring or use FPL, FPLP, FPLR, or an equivalent in accordance with the National Electrical Code.
9. The input for this riser is common to all modules.

Maximum Output Load		
24Vdc	**25V**	**70V**
Signals	Audio	Audio
2A	50W	35W

Typical Wiring (SIGA-CC1/MCC1)

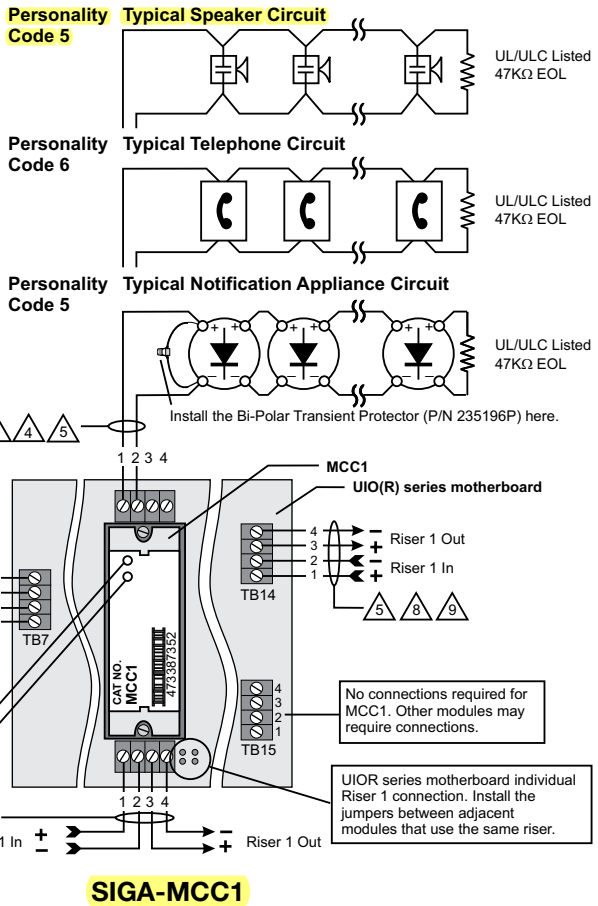
Modules will accept #18 AWG (0.75mm²), #16 (1.0mm²), #14 AWG (1.50mm²) and #12 (2.5mm²) wire sizes.

Note: Sizes #16 AWG (1.0mm²) and #18 AWG (0.75mm²) are preferred for ease of installation. See Signature Loop Controller catalog sheet for detailed wiring requirement specifications.



SIGA-CC1

Maximum Output Load		
24Vdc	**25V**	**70V**
Signals	Audio	Audio
2A	50W	35W



SIGA-MCC1

Notes

2. Maximum #12 AWG (2.5mm²) wire. Min. #18 (0.75mm²).
3. Refer to Signature Loop Controller Installation Sheet for wiring specifications.
4. These modules will NOT support two-wire smoke detectors.
5. All wiring power limited and supervised. If the input source is non-power limited, then maintain spacing of 1/4 inch or use FPL, FPLP, FPLR or equivalent in accordance with NEC.
6. The SIGA-UIO6 does not come with TB8 through TB13.
7. Supervised and power-limited.
8. If the source is nonpower-limited, maintain a space of 1/4 inch from power-limited wiring or use FPL, FPLP, FPLR, or an equivalent in accordance with the National Electrical Code.
9. The input for this riser is common to all modules.

Signature Series Overview

The Signature Series intelligent analog-addressable system from EDWARDS is an entire family of multi-sensor detectors and mounting bases, multiple-function input and output modules, network and non-network control panels, and user-friendly maintenance and service tools. Analog information from equipment connected to Signature devices is gathered and converted into digital signals. An onboard microprocessor in each Signature device measures and analyzes the signal and decides whether or not to input an alarm. The microprocessor in each Signature device provides four additional benefits – Self-diagnostics and History Log, Automatic Device Mapping, and Fast, Stable Communication.

Self-diagnostics and History Log – Each Signature Series device constantly runs self-checks to provide important maintenance information. The results of the self-check are automatically updated and permanently stored in its non-volatile memory. This information is accessible for review any time at the control panel, PC, or using the SIGA-PRO Signature Program/ Service Tool. The information stored in device memory includes:

- Device serial number, address, and type
- Time and date of last alarm (EST3 V 2 only.)
- Most recent trouble code logged by the detector — 32 possible trouble codes may be used to diagnose faults.

Automatic Device Mapping –The Signature Data Controller (SDC) learns where each device's serial number address is installed relative to other devices on the circuit. The SDC keeps a map of all Signature Series devices connected to it. The Signature Series Data Entry Program also uses the mapping feature. With interactive menus and graphic support, the wired circuits between each device can be examined. Layout or "as-built" drawing information showing branch wiring (T-taps), device types and their address are stored on disk for printing hard copy. This takes the mystery out of the installation. The preparation of as-built drawings is fast and efficient.

Device mapping allows the Signature Data Controller to discover:

- Unexpected additional device addresses
- Missing device addresses
- Changes to the wiring in the circuit.

Most Signature modules use a personality code selected by the installer to determine their actual function. Personality codes are downloaded from the SDC during system configuration and are indicated during device mapping.

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Specifications

Catalog Number	SIGA-CC1	SIGA-MCC1	SIGA-CC2	SIGA-MCC2
Description	Single Input (Riser) Signal Module		Dual Input (Riser) Signal Module	
Type Code	50 (factory set) Two sub-types (personality codes) are available		51 (factory set) One sub-type (personality code) is available (factory set)	
Address Requirements	Uses one module address		Uses two module addresses	
Wiring Terminations	Suitable for #12 to #18 AWG (2.5 mm² to 0.75mm²)			
Mounting	North American 2½ inch (64 mm) deep two-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 2-gang covers and SIGA-MP mounting plates	Plugs into UIO2R, UIO6R or UIO6 Motherboards	North American 2½ inch (64 mm) deep two-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 2-gang covers and SIGA-MP mounting plates	Plugs into UIO2R, UIO6R or UIO6 Motherboards
Operating Current	Standby = 223µA Activated = 100µA			
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)			
Output Rating	24 Vdc = 2 amps 25 V Audio = 50 watts 70 V Audio = 35 watts			
Construction	High Impact Engineering Polymer			
Storage & Operating Environment	Operating Temperature: 32°F to 120°F (0°C to 49°C) Storage Temperature: -4°F to 140°F (-20°C to 60°C) Humidity: 0 to 93% RH			
LED Operation	On-board Green LED - Flashes when polled On-board Red LED - Flashes when in alarm/active			
Compatibility	Use with: Signature Loop Controller			
Agency Listings	UL, ULC, CSFM, MEA, FM			

Ordering Information

Catalog Number	Description	Ship Wt. lbs (kg)
SIGA-CC1	Single Input Signal Module (Standard Mount) - UL/ULC Listed	0.5 (0.23)
SIGA-MCC1	Single Input Signal Module (UIO Mount) - UL/ULC Listed	0.18 (0.08)
SIGA-CC2	Dual Input Signal Module (Standard Mount) - UL/ULC Listed	0.5 (0.23)
SIGA-MCC2	Dual Input Signal Module (UIO Mount) - UL/ULC Listed	0.18 (0.08)
Related Equipment		
27193-21	Surface Mount Box - Red, 2-gang	2 (1.2)
27193-26	Surface Mount Box - White, 2-gang	2 (1.2)
SIGA-UIO2R	Universal Input-Output Module Board w/Riser Inputs - Two Module Positions	0.32 (0.15)
SIGA-UIO6R	Universal Input-Output Module Board w/Riser Inputs - Six Module Positions	0.62 (0.28)
SIGA-UIO6	Universal Input-Output Module Board - Six Module Positions	0.56 (0.25)
235196P	Bi-polar Transient Protector	0.01 (0.05)
Accessories		
MFC-A	Multifunction Fire Cabinet - Red, supports Signature Module Mounting Plates	7.0 (3.1)
SIGA-MP1	Signature Module Mounting Plate, 1 footprint	1.5 (0.70)
SIGA-MP2	Signature Module Mounting Plate, 1/2 footprint	0.5 (0.23)
SIGA-MP2L	Signature Module Mounting Plate, 1/2 extended footprint	1.02 (0.46)

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Input Modules

SIGA-CT1, SIGA-CT1HT, SIGA-CT2, SIGA-MCT2



SIGA-MCT2



SIGA-CT1/2

FM APPROVED MEA

7300-1657: 0121

S3424

Overview

The SIGA-CT1 Single Input Module, SIGA-CT1HT High Temperature Single Input Module and SIGA-CT2/SIGA-MCT2 Dual Input Modules are intelligent analog addressable devices used to connect one or two Class B normally-open Alarm, Supervisory, or Monitor type dry contact Initiating Device Circuits (IDC).

The actual function of these modules is determined by the "personality code" selected by the installer. This code is downloaded to the module from the Signature loop controller during system configuration.

The input modules gather analog information from the initiating devices connected to them and convert it into digital signals. The module's on-board microprocessor analyzes the signal and decides whether or not to input an alarm.

The SIGA-CT1, SIGA-CT1HT and SIGA-CT2 mount to standard North American 1-gang electrical boxes, making them ideal for locations where only one module is required. Separate I/O and data loop connections are made to each module.

The SIGA-CT1HT module operates at an expanded temperature range of 32 ºF to 158 ºF (0 ºC to 70 ºC) for those applications requiring more extreme environmental temperature variation.

The SIGA-MCT2 is part of the UIO family of plug-in Signature Series modules. It functions identically to the SIGA-CT2, but takes advantage of the modular flexibility and easy installation that characterizes all UIO modules. Two- and six-module UIO motherboards are available. All wiring connections are made to terminal blocks on the motherboard. UIO assemblies may be mounted in EDWARDS enclosures.

Standard Features

- **Multiple applications**
  Including Alarm, Alarm with delayed latching (retard) for waterflow applications, Supervisory, and Monitor. The installer selects one of four "personality codes" to be downloaded to the module through the loop controller.
- **SIGA-CT1HT rated for high temperature environments**
  Suitable for attic installation and monitoring high temperature heat detectors.
- **Plug-in (UIO) or standard 1-gang mount**
  UIO versions allow quick installation where multiple modules are required. The 1-gang mount version is ideal for remote locations that require a single module.
- **Automatic device mapping**
  Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Electronic addressing**
  Programmable addresses are downloaded from the loop controller, a PC, or the SIGA-PRO Signature Program/Service Tool. There are no switches or dials to set.
- **Ground fault detection by address**
  Detects ground faults right down to the device level.

Signature Series Overview

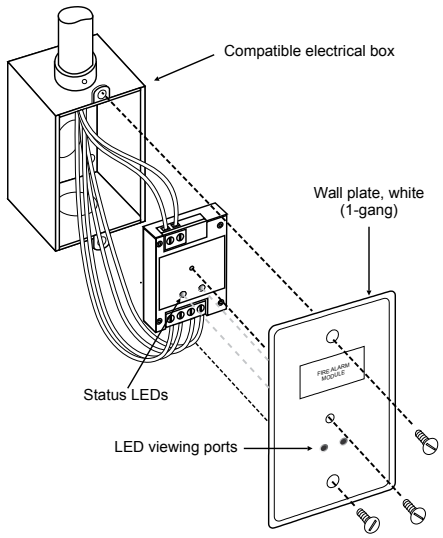
The Signature Series intelligent analog-addressable system from EDWARDS Security is an entire family of multi-sensor detectors and mounting bases, multiple-function input and output modules, network and non-network control panels, and user-friendly maintenance and service tools. Analog information from equipment connected to Signature devices is gathered and converted into digital signals. An onboard microprocessor in each Signature device measures and analyzes the signal and decides whether or not to input an alarm. The microprocessor in each Signature device provides four additional benefits – Self-diagnostics and History Log, Automatic Device Mapping, and Fast, Stable Communication.

Self-diagnostics and History Log – Each Signature Series device constantly runs self-checks to provide important maintenance information. The results of the self-check are automatically updated and permanently stored in its non-volatile memory. This information is accessible for review any time at the control panel, PC, or using the SIGA-PRO Signature Program/ Service Tool.

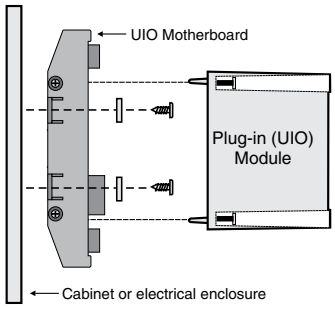
Automatic Device Mapping –The Signature Data Controller (SDC) learns where each device's serial number address is installed relative to other devices on the circuit. The SDC keeps a map of all Signature Series devices connected to it. The Signature Series Data Entry Program also uses the mapping feature. With interactive menus and graphic support, the wired circuits between each device can be examined. Layout or "as-built" drawing information showing branch wiring (T-taps), device types and their address are stored on disk for printing hard copy.

Installation

SIGA-CT1, SIGA-CT1HT and SIGA-CT2: modules mount to North American 2½ inch(64 mm) deep 1-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 1-gang covers and SIGA-MP mounting plates. The terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



SIGA-MCT2: mount the UIO motherboard inside a suitable EDWARDS enclosure with screws and washers provided. Plug the SIGA-MCT2 into any available position on the motherboard and secure the module to the motherboard with the captive screws. Wiring connections are made to the terminals on the motherboard (see wiring diagram). UIO motherboard terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



Electronic Addressing - The loop controller electronically addresses each module, saving valuable time during system commissioning. Setting complicated switches or dials is not required. Each module has its own unique serial number stored in its on-board memory. The loop controller identifies each device on the loop and assigns a "soft" address to each serial number. If desired, the modules can be addressed using the SIGA-PRO Signature Program/Service Tool.

EDWARDS recommends that this module be installed according to latest recognized edition of national and local fire alarm codes.

Application

The duty performed by the SIGA-CT1 and SIGA-CT2/MCT2 is determined by their sub-type code or "Personality Code". The code is selected by the installer depending upon the desired application and is downloaded from the loop controller.

One personality code can be assigned to the SIGA-CT1. Two personality codes can be assigned to the SIGA-CT2/MCT2. Codes 1, 2, 3 and 4 can be mixed on SIGA-CT2/MCT2 modules only. For example, personality code 1 can be assigned to the first address (circuit A) and code 4 can be assigned to the second address (circuit B).

NORMALLY-OPEN ALARM - LATCHING (Personality Code 1) - Assign to one or both circuits. Configures either circuit A or B or both for Class B normally open dry contact initiating devices such as Pull Stations, Heat Detectors, etc. An ALARM signal is sent to the loop controller when the input contact is closed. The alarm condition is latched at the module.

NORMALLY-OPEN ALARM - DELAYED LATCHING (Personality Code 2) - Assign to one or both circuits. Configures either circuit A or B or both for Class B normally-open dry contact initiating devices such as Waterflow Alarm Switches. An ALARM signal is sent to the loop controller when the input contact is closed for approximately 16 seconds. The alarm condition is latched at the module.

NORMALLY-OPEN ACTIVE - NON-LATCHING (Personality Code 3) - Assign to one or both circuits. Configures either circuit A or B or both for Class B normally-open dry contact monitoring input such as from Fans, Dampers, Doors, etc. An ACTIVE signal is sent to the loop controller when the input contact is closed. The active condition is not latched at the module.

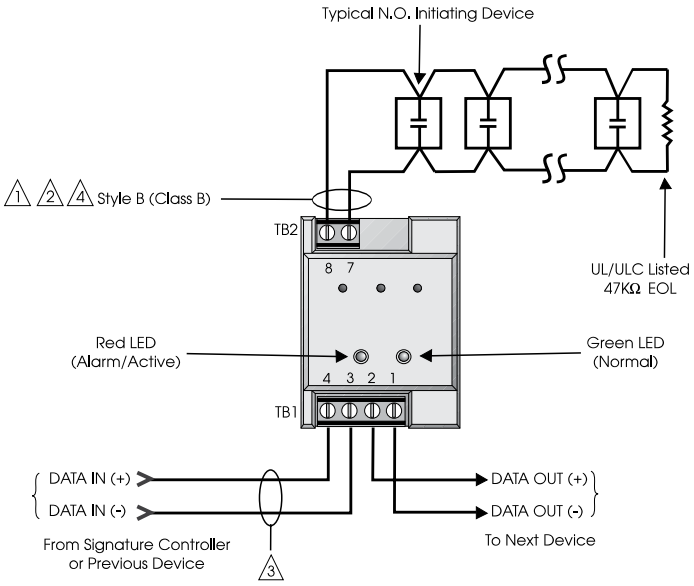
NORMALLY-OPEN ACTIVE - LATCHING (Personality Code 4) - Assign to one or both circuits. Configures either circuit A or B or both for Class B normally open dry contact monitoring input such as from Supervisory and Tamper Switches. An ACTIVE signal is sent to the loop controller when the input contact is closed. The active condition is latched at the module.

Typical Wiring

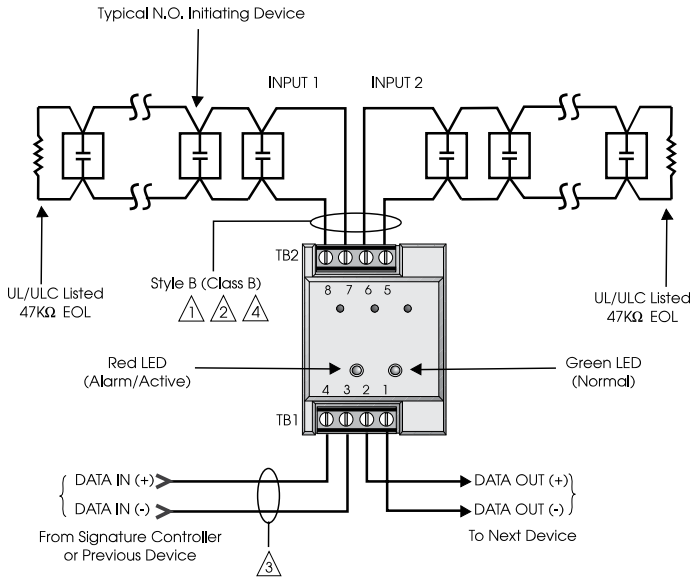
Modules will accept #18 AWG (0.75mm^2), #16 (1.0mm^2), and #14AWG (1.50mm^2), and #12 AWG (2.50mm^2) wire sizes.

Note: Sizes #16 AWG (1.0mm^2) and #18 AWG (0.75mm^2) are preferred for ease of installation. See Signature Loop Controller catalog sheet for detailed wiring requirement specifications.

Initiating (Slave) Device Circuit Wire Specifications		
Maximum Allowable Wire Resistance	50 ohms (25 ohms per wire) per Circuit	
Maximum Allowable Wire Capacitance	0.1µF per Circuit	
For Design Reference:	**Wire Size**	**Maximum Distance to EOLR**
	#18 AWG (0.75 mm^2)	4,000 ft (1,219 m)
	#16 AWG (1.00 mm^2)	
	#14 AWG (1.50 mm^2)	
	#12 AWG (1.50 mm^2)	



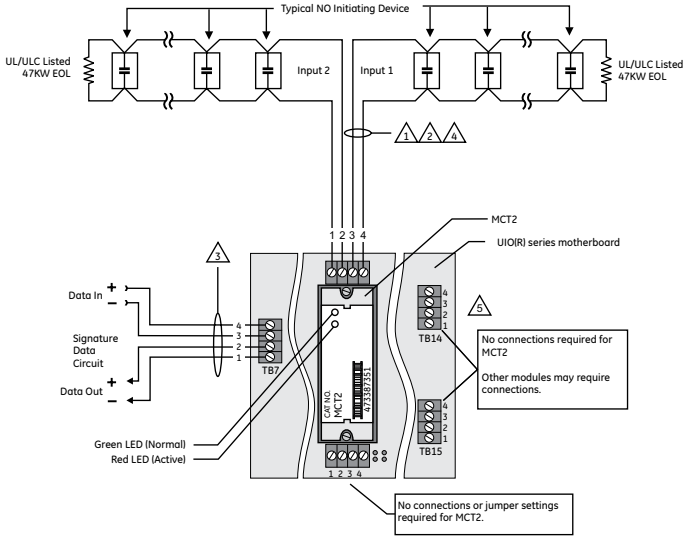
SIGA-CT1, SIGA-CT1HT



SIGA-CT2

NOTES

1. **Maximum 25 Ohm resistance per wire.**
2. **Maximum #12 AWG (2.5 mm^2) wire; Minimum #18 AWG (0.75 mm2).**
3. **Refer to Signature controller installation sheet for wiring specifications.**
4. **Maximum 10 Vdc @ 350 µA**
5. **The SIGA-UIO6R and the SIGA-UIO2R do not come with TB14.**
6. **All wiring is supervised and power-limited.**
7. **These modules will not support 2-wire smoke detectors.**



SIGA-MCT2

Warnings & Cautions

This module will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your local fire protection specialist.

Compatibility

These modules are part of EDWARDS's Signature Series intelligent processing and control platform. They are compatible with EST3, EST3X and iO Series control panels.

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Specifications

Catalog Number	SIGA-CT1HT	SIGA-CT1	SIGA-CT2	SIGA-MCT2
Description	Single Input Module		Dual Input Module	
Type Code	48 (factory set) Four sub-types (personality codes) are available		49 (factory set) Four sub-types (personality codes) are available	
Address Requirements	Uses One Module Address		Uses Two Module Addresses	
Operating Current	Standby = 250µA; Activated = 400µA		Standby = 396µA; Activated = 680µA	
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)			
Construction	High Impact Engineering Polymer			
Mounting	North American 2½ inch (64 mm) deep one-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with one-gang covers and SIGA-MP mounting plates			UIO2R/6R/6 Motherboard
Operating Environment	32°F to 158°F (0°C to 70°C)	32°F to 120°F (0°C to 49°C)		
Storage Environment	-4°F to 140°F (-20°C to 60°C); Humidity: 0 to 93% RH			
LED Operation	On-board Green LED - Flashes when polled; On-board Red LED - Flashes when in alarm/active.			
Compatibility	Use with Signature Loop Controller			
Agency Listings	UL, ULC, MEA, CSFM			

Ordering Information

Catalog Number	Description	Ship Wt. lbs (kg)
SIGA-CT1	Single Input Module — UL/ULC Listed	0.4 (0.15)
SIGA-CT1HT	Single Input Module High Temperature Operation UL/ULC Listed	0.4 (0.15)
SIGA-CT2	Dual Input Module — UL/ULC Listed	0.4 (0.15)
SIGA-MCT2	Dual Input Plug-in (UIO) Module — UL, ULC Listed	0.1 (0.05)

Related Equipment		
27193-11	Surface Mount Box - Red, 1-gang	1.0 (0.6)
27193-16	Surface Mount Box - White, 1-gang	1.0 (0.6)
SIGA-UIO2R	Universal Input-Output Module Board w/Riser Inputs — Two Module Positions	0.32 (0.15)
SIGA-UIO6R	Universal Input-Output Module Board w/Riser Inputs — Six Module Positions	0.62 (0.28)
SIGA-UIO6	Universal Input-Output Module Board — Six Module Positions	0.56 (0.25)
MFC-A	Multifunction Fire Cabinet — Red, supports Signature Module Mounting Plates	7.0 (3.1)
SIGA-MB4	Transponder Mounting Bracket (allows for mounting two 1-gang modules in a 2-gang box)	0.4 (0.15)
SIGA-MP1	Signature Module Mounting Plate, 1 footprint	1.5 (0.70)
SIGA-MP2	Signature Module Mounting Plate, 1/2 footprint	0.5 (0.23)
SIGA-MP2L	Signature Module Mounting Plate, 1/2 extended footprint	1.02 (0.46)

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Control Relay Modules

SIGA-CR, SIGA-MCR, SIGA-CRR, SIGA-MCRR



SIGA-MCR



SIGA-CR

FM APPROVED MEA 7300-1657: 0121 S3424

Overview

The Control Relay Module and the Polarity Reversal Relay Module are part of the Signature Series system. They are intelligent analog addressable devices available in either plug-in (UIO) versions, or standard 1-gang mount versions.

The SIGA-CR/MCR Control Relay Module provides a Form "C" dry relay contact to control external appliances such as door closers, fans, dampers etc. This device does not provide supervision of the state of the relay contact. Instead, the on-board microprocessor ensures that the relay is in the proper ON/OFF state. Upon command from the loop controller, the SIGA-CR/MCR relay activates the normally open or normally-closed contact.

The SIGA-CRR/MCRR Polarity Reversal Relay Module provides a Form "C" dry relay contact to power and activate a series of SIGA-AB4G Audible Sounder Bases. Upon command from the Signature loop controller, the SIGA-CRR reverses the polarity of its 24 Vdc output, thus activating all Sounder Bases on the data loop.

Standard-mount versions (SIGA-CR and SIGA-CRR) are installed to standard North American 1-gang electrical boxes, making them ideal for locations where only one module is required. Separate I/O and data loop connections are made to each module.

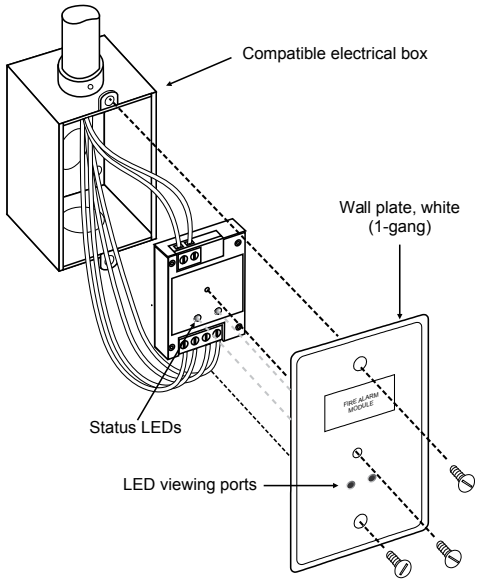
Plug-in UIO versions (SIGA-MCR and SIGA-MCRR) are part of the UIO family of plug-in Signature Series modules. They function identically to the standard mount versions, but take advantage of the modular flexibility and easy installation that characterizes all UIO modules. Two- and six-module UIO motherboards are available. All wiring connections are made to terminal blocks on the motherboard. UIO assemblies may be mounted in EDWARDS enclosures.

Standard Features

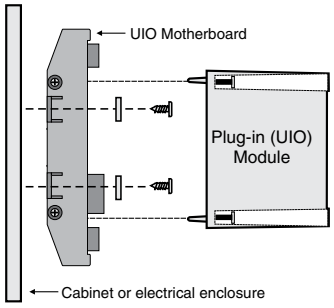
- **Provides one no/nc contact (SIGA-CR/MCR)**
  Form "C" dry relay contact can be used to control external appliances such as door closers, fans, dampers etc.
- **Allows group operation of sounder bases**
  The SIGA-CRR/MCRR reverses the polarity of its 24 Vdc output, thus activating all Sounder Bases on the data loop.
- **Plug-in (UIO) or standard 1-gang mount**
  UIO versions allow quick installation where multiple modules are required. The 1-gang mount version is ideal for remote locations that require a single module.
- **Automatic device mapping**
  Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Electronic addressing**
  Programmable addresses are downloaded from the loop controller, a PC, or the SIGA-PRO Signature Program/Service Tool; there are no switches or dials to set.
- **Intelligent device with microprocessor**
  All decisions are made at the module to allow lower communication speed with substantially improved control panel response time and less sensitivity to line noise and loop wiring properties; twisted or shielded wire is not required.

Installation

SIGA-CR and SIGA-CRR: modules mount to North American 2½ inch (64 mm) deep 1-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 1-gang covers and SIGA-MP mounting plates. The terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



SIGA-MCR and SIGA-MCRR: mount the UIO motherboard inside a suitable EDWARDS enclosure with screws and washers provided. Plug the module into any available position on the motherboard and secure the module to the motherboard with the captive screws. Wiring connections are made to the terminals on the motherboard (see wiring diagram). UIO motherboard terminals are suited for #12 to #18 AWG (2.5 mm^2 to 0.75 mm^2) wire size.



Electronic Addressing - The loop controller electronically addresses each module, saving valuable time during system commissioning. Setting complicated switches or dials is not required. Each module has its own unique serial number stored in its on-board memory. The loop controller identifies each device on the loop and assigns a "soft" address to each serial number. If desired, the modules can be addressed using the SIGA-PRO Signature Program/Service Tool.

EDWARDS recommends that this module be installed according to latest recognized edition of national and local fire alarm codes.

Application

The operation of Signature Series control relays is determined by their sub-type code or "Personality Code."

Personality Code 8: CONTROL RELAY (SIGA-CR/MCR) - Dry Contact Output. This setting configures the module to provide one Form "C" DRY RELAY CONTACT to control Door Closers, Fans, Dampers, etc. Contact rating is 2.0 amp @ 24 Vdc; 0.5 amp @ 120 Vac (or 0.25A @ 220 Vac for non-UL applications). Personality Code 8 is assigned at the factory. No user configuration is required.

Personality Code 8: POLARITY REVERSAL RELAY MODULE (SIGA-CRR/MCRR). This setting configures the module to reverse the polarity of its 24 Vdc output. Contact rating is 2.0 amp @ 24 Vdc (pilot duty). Personality Code 8 is assigned at the factory. No user configuration is required.

Compatibility

These modules are part of EDWARDS's Signature Series intelligent processing and control platform. They are compatible with EST3, EST3X and iO Series control panels.

Warnings & Cautions

This module will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your local fire protection specialist.

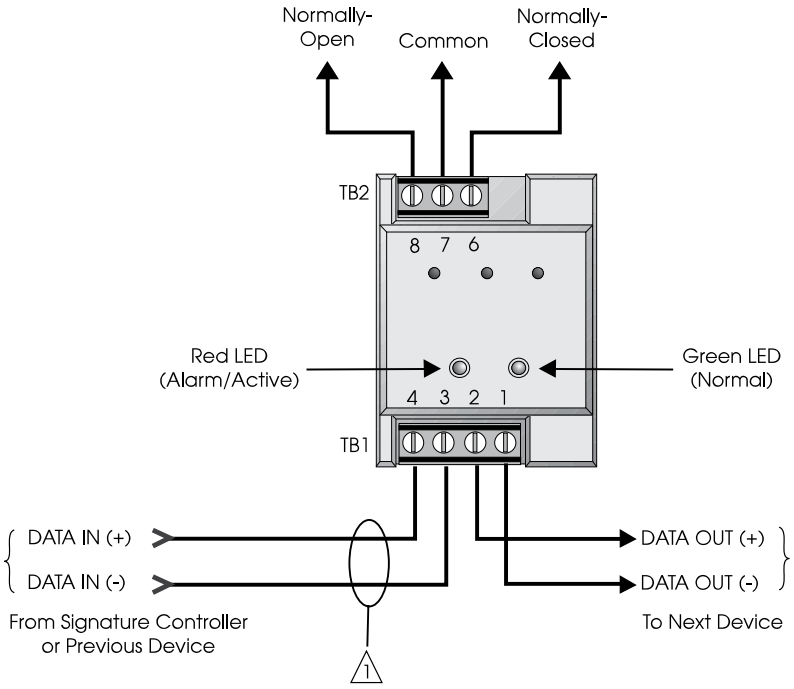
Testing & Maintenance

The module's automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each module and other pertinent messages. Single modules may be turned off (deactivated) temporarily, from the control panel. Availability of maintenance features is dependent on the fire alarm system used. Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

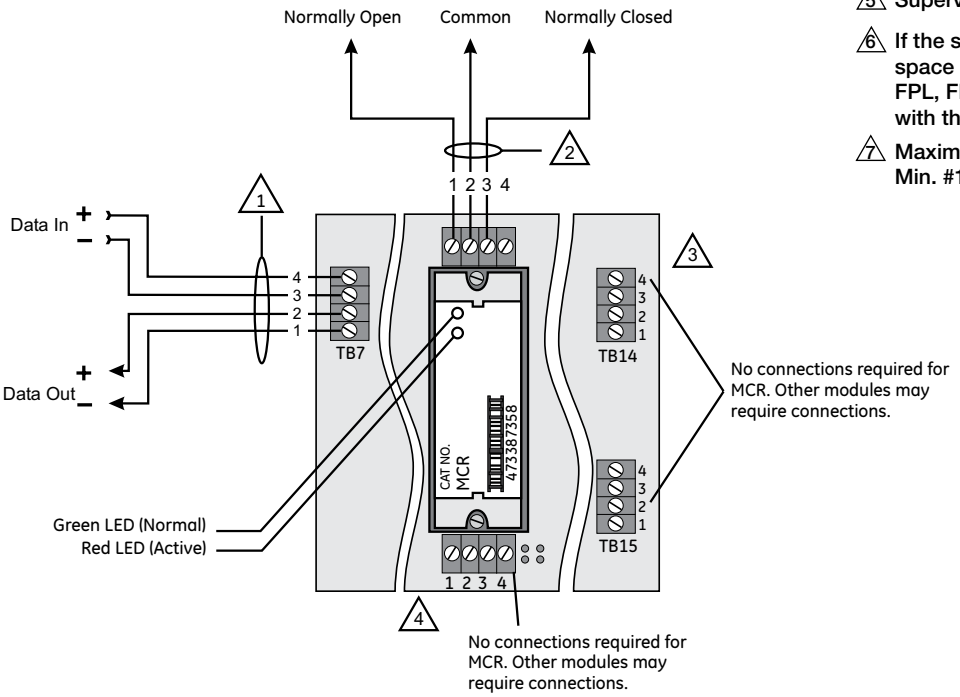
Typical Wiring

Modules will accept #18 AWG (0.75mm^2), #16 (1.0mm^2), #14 AWG (1.50mm^2) and #12 AWG (2.5mm^2) wire sizes.

Note: Sizes #16 AWG (1.0mm^2) and #18 AWG (0.75mm^2) are preferred for ease of installation. See Signature Loop Controller catalog sheet for detailed wiring requirement specifications.



SIGA-CR Control Relay



SIGA-MCR Control Relay

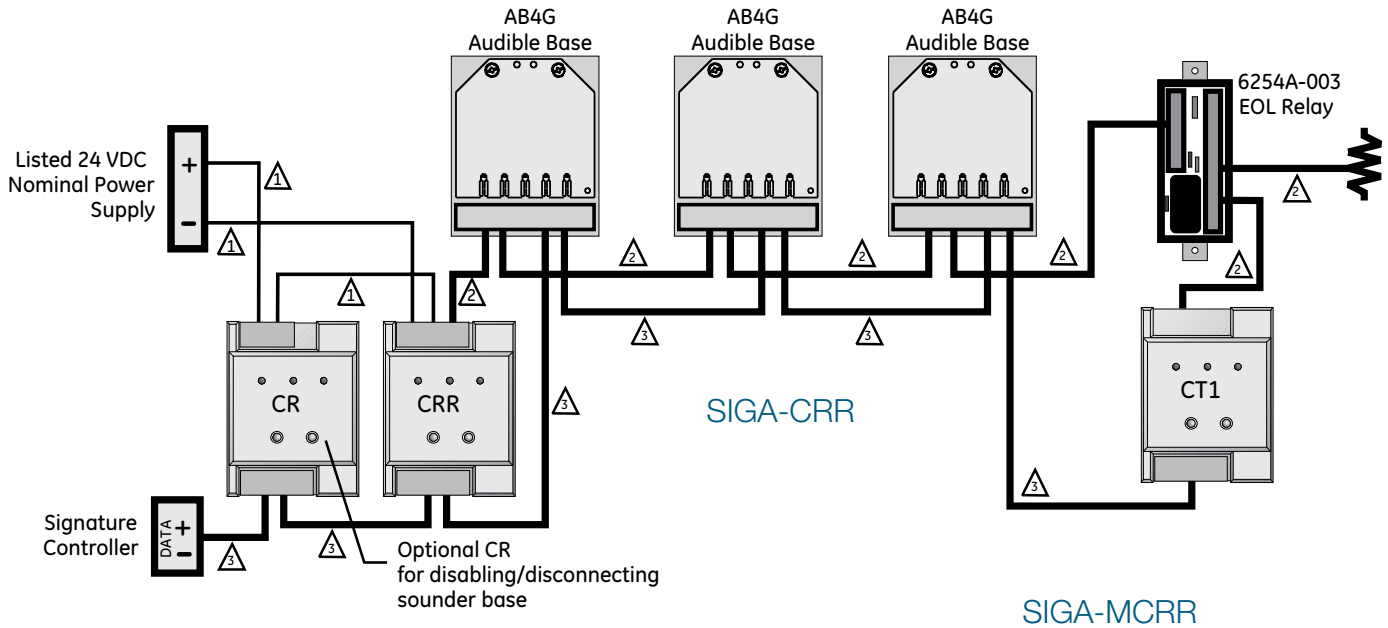
Notes

1. Refer to Signature Loop Controller Installation Sheet for wiring specifications.
2. NFPA 72 requires that the SIGA-CR/SIGA-MCR be installed in the same room as the device it is controlling. This requirement may not apply in all markets. Check with your local AHJ for details.
3. The SIGA-UIO6R and the SIGA-UIO2R do not come with TB14.
4. The SIGA-UIO6 does not come with TB8 through TB13.
5. Supervised and power-limited.
6. If the source is nonpower-limited, maintain a space of 1/4 inch from power-limited wiring or use FPL, FPLP, FPLR, or an equivalent in accordance with the National Electrical Code.
7. Maximum #12 AWG (2.5mm^2) wire. Min. #18 (0.75mm^2).

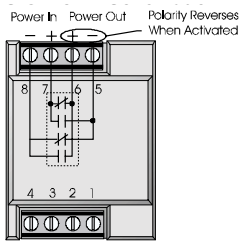
Typical Wiring

Modules will accept #18 AWG (0.75mm^2), #16 (1.0mm^2), #14 AWG (1.50mm^2) and #12 AWG (2.50mm^2) wire sizes.

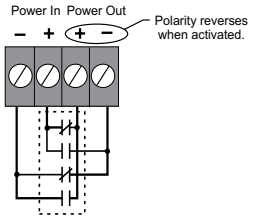
Note: Sizes #16 AWG (1.0mm^2) and #18 AWG (0.75mm^2) are preferred for ease of installation. See Signature Loop Controller catalog sheet for detailed wiring requirement specifications.



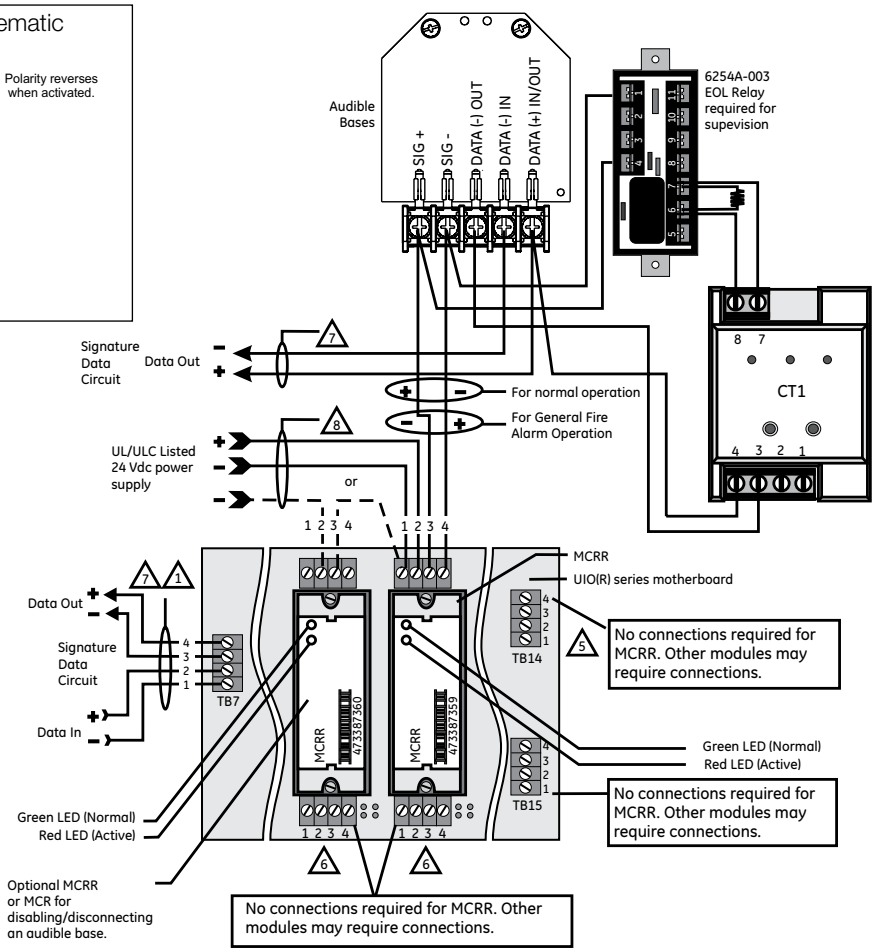
SIGA-CRR Schematic



SIGA-MCRR Schematic



SIGA-MCRR



Notes

1. Refer to the Signature controller installation sheet for wiring.
2. One Pair of Wires (24 Vdc power).
3. One Pair of Wires (Signature Data).
4. Single Wire (24 Vdc power).
5. The SIGA-UIO6R and the SIGA-UIO2R do not come with TB14.
6. The SIGA-UIO6 does not come with TB8 through TB13.
7. Supervised and power-limited.
8. If the source is nonpower-limited, maintain a space of 1/4 inch from power-limited wiring or use FPL, FPLP, FPLR, or an equivalent in accordance with the National Electrical Code.
9. Maximum #12 AWG (2.5 mm^2) wire; Minimum #18 AWG (0.75 mm^2).
10. End-of-Line Relay must monitor and report power supply trouble to control panel.
11. Class B Data wiring may be “T-tapped.”

Specifications

Catalog Number	SIGA-CR	SIGA-MCR	SIGA-CRR	SIGA-MCRR
Description	Control Relay		Polarity Reversal Relay	
Type Code	Personality Code 8 (Factory Set)		Personality Code 8 (Factory Set)	
Address Requirements	Uses 1 Module Address			
Operating Current	Standby = 75 µA Activated = 75 µA			
Operating Voltage	15.2 to 19.95 Vdc (19 Vdc nominal)			
Relay Type and Rating	Form C, 2 Amps @ 24 Vdc (pilot duty), 0.5 Amps @ 120 Vac and 0.25 Amps @ 220 Vac (220 Vac is non-UL) Not rated for capacitive loads.			
Mounting	North American 2½ inch (64 mm) deep 1-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 1-gang covers and SIGA-MP mounting plates	Plugs into UIO2R, UIO6R or UIO6 Motherboards	North American 2½ inch (64 mm) deep 1-gang boxes and 1½ inch (38 mm) deep 4 inch square boxes with 1-gang covers and SIGA-MP mounting plates	Plugs into UIO2R, UIO6R or UIO6 Motherboards
Construction & Finish	High Impact Engineering Polymer			
Storage and Operating Environment	Operating Temperature: 32°F to 120°F (0°C to 49°C) Storage Temperature: -4°F to 140°F (-20°C to 60°C) Humidity: 0 to 93% RH			
LED Operation	On-board Green LED - Flashes when polled On-board Red LED - Flashes when in alarm/active			
Compatibility	Use With: Signature Loop Controller			
Agency Listings	UL, ULC, CSFM, MEA			

Ordering Information

Catalog Number	Description	Ship Weight - lbs (kg)
SIGA-CR	Control Relay Module (Standard Mount)	0.4 (0.15)
SIGA-MCR	Control Relay Module (UIO Mount)	0.18 (0.08)
SIGA-CRR	Polarity Reversal Relay Module (Standard Mount)	0.4 (0.15)
SIGA-MCRR	Polarity Reversal Relay Module (UIO Mount)	0.18 (0.08)
Related Equipment		
27193-11	Surface Mount Box - Red, 1-gang	1 (0.6)
27193-16	Surface Mount Box - White, 1-gang	1 (0.6)
SIGA-UIO2R	Universal Input-Output Module Board w/Riser Inputs - Two Module Positions	0.32 (0.15)
SIGA-UIO6R	Universal Input-Output Module Board w/Riser Inputs - Six Module Positions	0.62 (0.28)
SIGA-UIO6	Universal Input-Output Module Board - Six Module Positions	0.56 (0.25)
SIGA-AB4G	Audible (Sounder) Detector Base	0.3 (0.15)
Accessories		
MFC-A	Multifunction Fire Cabinet - Red, supports Signature Module Mounting Plates	7.0 (3.1)
SIGA-MB4	Transponder Mounting Bracket (allows for mounting two 1-gang modules in a 2-gang box)	0.4 (0.15)
SIGA-MP1	Signature Module Mounting Plate, 1 footprint	1.5 (0.70)
SIGA-MP2	Signature Module Mounting Plate, 1/2 footprint	0.5 (0.23)
SIGA-MP2L	Signature Module Mounting Plate, 1/2 extended footprint	1.02 (0.46)

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Signature Series Overview

The Signature Series intelligent analog-addressable system from EDWARDS is an entire family of multi-sensor detectors and mounting bases, multiple-function input and output modules, network and non-network control panels, and user-friendly maintenance and service tools. Analog information from equipment connected to Signature devices is gathered and converted into digital signals. An onboard microprocessor in each Signature device measures and analyzes the signal and decides whether or not to input an alarm. The microprocessor in each Signature device provides four additional benefits – Self-diagnostics and History Log, Automatic Device Mapping, and Fast, Stable Communication.

Self-diagnostics and History Log – Each Signature Series device constantly runs self-checks to provide important maintenance information. The results of the self-check are automatically updated and permanently stored in its non-volatile memory. This information is accessible for review any time at the control panel, PC, or using the SIGA-PRO Signature Program/Service Tool. The information stored in device memory includes:

- Device serial number, address, and type
- Time and date of last alarm
- Most recent trouble code logged by the detector — 32 possible trouble codes may be used to diagnose faults.

Automatic Device Mapping –The Signature Data Controller (SDC) learns where each device's serial number address is installed relative to other devices on the circuit. The SDC keeps a map of all Signature Series devices connected to it. The Signature Series Data Entry Program also uses the mapping feature. With interactive menus and graphic support, the wired circuits between each device can be examined. Layout or "as-built" drawing information showing branch wiring (T-taps), device types and their address are stored on disk for printing hard copy. This takes the mystery out of the installation. The preparation of as-built drawings is fast and efficient.

Device mapping allows the Signature Data Controller to discover:

- Unexpected additional device addresses
- Missing device addresses
- Changes to the wiring in the circuit.

Most Signature modules use a personality code selected by the installer to determine their actual function. Personality codes are downloaded from the SDC during system configuration and are indicated during device mapping.

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

High Power Control Relay Module

SIGA-CRH



Description

The SIGA-CRH High Power Control Relay Module is an addressable device designed for interface applications that require a high voltage, high current relay. Two identical sets of relay terminals are provided. Both sets of relay contacts transfer when the module is activated or restored. The state of the output terminals is not supervised.

The module requires one address on the signaling line circuit (SLC). The address is assigned electronically. There are no address switches to set.

Standard Features

- **High Power Rating**
  120/240 VAC or 24 VDC rated contact can be used to control external appliances such as door closers, fans, dampers etc.
- **Provides one relay with two Form C contacts**
  Relay accepts 12 to 18 AWG (1.0 to 4.0 mm²) wiring from two sources
- **Automatic device mapping**
  Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
- **Removable terminal blocks**
  Easy wiring and module replacement.
- **Electronic addressing**
  Programmable addresses are downloaded from the loop controller or PC; there are no switches or dials to set.
- **Intelligent device**
  Distributed intelligence allows lower communication speed with substantially improved control panel response time and less sensitivity to line noise and loop wiring properties; twisted or shielded wire is not required.

Application

Personality code

Use *Personality Code 8* to configure the SIGA-CRH module:

Personality code 8: Signal - dry contact output. Configures the module as a dry relay contact to control external appliances (door closers, fan controllers, dampers) or equipment shutdown.

Indication

The status LED shows the state of the module through the cover plate:

- Normal: Green LED flashes
- Alarm/active: Red LED flashes

Compatibility

The SIGA-CRH is part of the Signature Series intelligent processing and control platform. It is compatible with EST3, EST3X, and iO Series control panels.

Warnings & Cautions

The SIGA-CRH will not operate without electrical power. As fires frequently cause power interruption, we suggest you discuss further safeguards with your local fire protection specialist.

EDWARDS recommends that this module be installed according to latest recognized edition of national and local fire alarm codes.

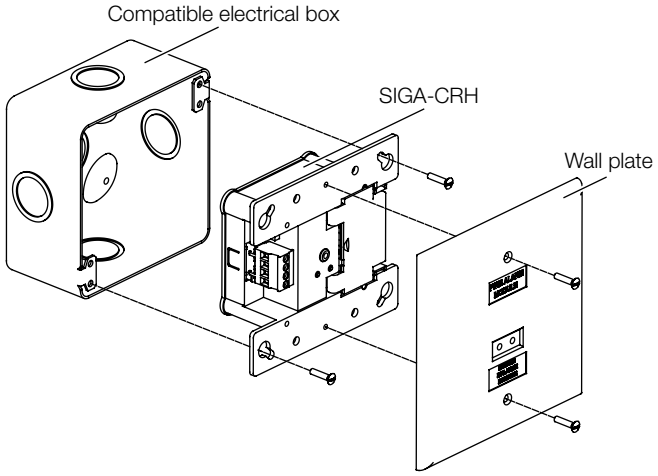
Testing & Maintenance

SIGA-CRH automatic self-diagnosis identifies when it is defective and causes a trouble message. The user-friendly maintenance program shows the current state of each module and other pertinent messages. Single modules may be turned off (deactivated) temporarily, from the control panel. Availability of maintenance features is dependent on the fire alarm system used. Scheduled maintenance (Regular or Selected) for proper system operation should be planned to meet the requirements of the Authority Having Jurisdiction (AHJ). Refer to current NFPA 72 and ULC CAN/ULC 536 standards.

Electronic Addressing

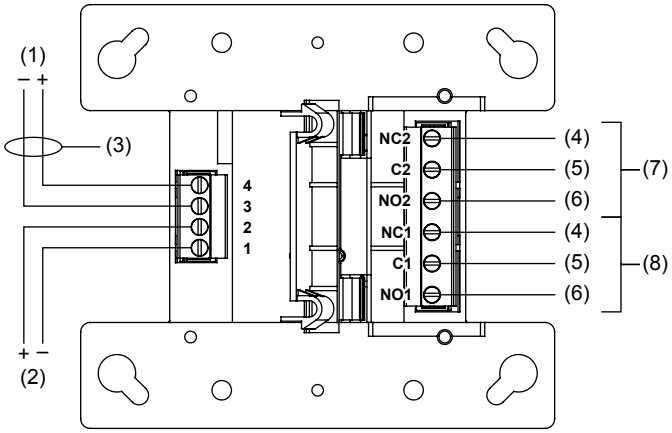
The loop controller electronically addresses the SIGA-CRH, saving valuable time during system commissioning. Setting complicated switches or dials is not required. The module has its own unique serial number stored in its on-board memory.

Installation



Consult the SIGA-CRH High Power Control Relay Module Installation Sheet for details.

Wiring



(1) Signaling line circuit (SLC) from previous device

(2) Signaling line circuit (SLC) to next device

(3) Power-limited and supervised

(4) Normally closed contact (NC)

(5) Common contact (C)

(6) Normally open contact (NO)

(7) Relay terminal set 2.
Not supervised. Power-limited unless connected to a nonpowerlimited source. If the source is nonpower-limited, eliminate the power-limited mark and maintain a minimum of 0.25 in. (6.4 mm) space from power-limited wiring. For other mounting methods, see enclosure and bracket installation sheets to maintain separation of power-limited and nonpower-limited wiring. The wire size must be capable of handling fault current from a nonpower-limited source.

— or —

Use type FPL, FPLR, FPLP, or permitted substitute cables, provided these power-limited cable conductors extending beyond the jacket are separated by a minimum of 0.25 in. (6.4 mm) space or by a nonconductive sleeve or nonconductive barrier from all other conductors. Refer to the NFPA 70 National Electrical Code for more details.

(8) Relay terminal set 1. Identical to (7).

Specifications

SLC operating voltage	15.20 to 19.95 VDC
SLC current	
Standby	75 µA max.
Activated	75 µA max.
Contact ratings [1][2]	
240 V 50/60 Hz	7 A (PF 0.75), 1.5 A (PF 0.35)
120 V 50/60 Hz	7 A (PF 0.75), 3.0 A (PF 0.35)
24 VDC	6 A resistive
Audio switching	0 to 20 kHz [3]
Relay type	2 Form C, programmable
Relay ready delay	
From power up	30 s max. (includes initial state set)
From previous activation	5 s max. (one activation) 8 s max. (two activations, 1 s apart)
Circuit designation	
Signaling line circuits	Class A, Style 6 or Class B, Style 4. Refer to the control panel technical publications for SLC wiring details.
Relay circuits	Class E
Number of SIGA-CRH per SLC	60 max.
Wire size	12 to 18 AWG (1.0 to 4.0 mm^2)
Compatible electrical boxes	North American double-gang × 2-1/8 in. (54 mm) deep box North American standard 4 in. square × 2-1/8 in. (54 mm) deep box
Agency Listings	CAN/ULC-S527, UL 864
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93%, noncondensing
Storage temperature	–4 to 140°F (–20 to 60°C)

[1] Provide external fusing and back-EMF mitigation as required by your application. Do not use the SIGA-CRH in a mixed application, where one set of relay terminals has high-power requirements and the other set carries a low-power signal, as this may result in physical contamination of the low-power signal contacts.

[2] The minimum load required in order to avoid long-term contact oxidation is 100 mA and 12 V.

[3] Power must not exceed the contact ratings shown for a given PF (power factor).

Ordering Information

Catalog Number	Description	Ship Weight lbs (kg)
SIGA-CRH	High Power Control Relay Module	0.4 (0.15)

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EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Intelligent Heat Detectors

SIGA-HRD, SIGA-HFD



S853

Overview

The Signature Series smoke detectors bring advanced sensing technology to a practical design that increases efficiency, saves installation time, cuts costs, and extends property protection capabilities. Continuous self-diagnostics ensures reliability over the long-haul, while the latest thermister technology makes these detectors ideal wherever dependable heat detection is required.

The SIGA-HRD is an intelligent fixed temperature/rate-of-rise fire detector. It monitors the temperature of the surrounding air and analyzes the data from the sensor to determine whether to initiate an alarm. The rate-of-rise heat function quickly detects a fast, flaming fire. The fixed-temperature heat function detects fire when the air temperature near the detector exceeds the alarm point.

The SIGA-HFD is an intelligent fixed-temperature heat detector that contains a fixed-temperature heat sensor rated at 135 °F (57.2 °C). It does not have a rate-of-rise function. The heat sensor monitors the temperature of the air in its surroundings and the detector analyzes the data to determine when the air temperature near the detector exceeds the device's alarm point.

Standard Features

Note: *Some features described here may not be supported by all control systems. Check your control panel's Installation and Operation Guide for details.*

- Next Generation Heat Sensing Technology
- 135 °F (57 °C) fixed temperature alarm point (HRD and HFD)
- 15 °F (9 °C) per minute rate-of-rise alarm point (HRD)
- Uses existing wiring
- Automatic device mapping
- Sensor Markings Provide Easy Testing Identification
- Up To 250 Total Signature Devices Per Loop
- Non-volatile memory
- Electronic addressing
- Bicolor (green/red) status LED
- Standard, relay, fault isolator, and audible mounting bases
- 50 foot (15.2 meter) spacing

Application

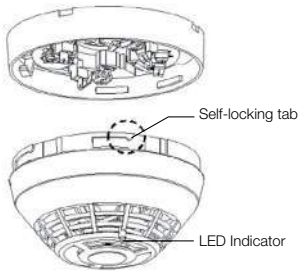
The SIGA-HRD combination fixed temperature/rate-of-rise heat detector provides a 15 °F (9 °C) per minute rate-of-rise heat sensor for the detection of fast-developing fires, as well as a 135°F (57°C) fixed temperature sensor for slow building-fires. The SIGA-HFD fixed temperature detector provides a 135°F (57°C) fixed temperature sensor for slow building-fires.

Compatibility

Signature Series heat detectors are compatible only with the Signature Loop Controller.

Installation

Signature Series detectors mount to North American 1-gang boxes, 3-1/2 inch or 4 inch octagon boxes, and to 4 inch square electrical boxes 1-1/2 inches (38 mm) deep. They mount to European BESA and 1-gang boxes with 60.3 mm fixing centers. See mounting base installation and wiring for more information.



Sensing and reporting technology

The microprocessor in each detector provides additional benefits - Self-diagnostics and History Log, Automatic Device Mapping, and Fast, Stable Communication.

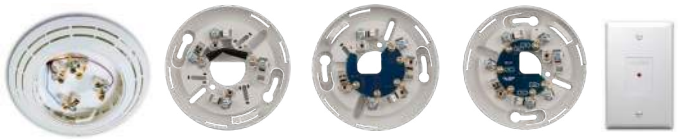
Self-diagnostics and History Log - Each Signature Series detector constantly runs self-checks to provide important maintenance information. The results of the self-check are automatically updated and permanently stored in the detector's non-volatile memory.

Automatic Device Mapping - The loop controller learns where each device's serial number address is installed relative to other devices on the circuit. The mapping feature provides supervision of each device's installed location to prevent a detector from being reinstalled (after cleaning etc.) in a different location from where it was originally.

Fast Stable Communication - On-board intelligence means less information needs to be sent between the detector and the loop controller. Other than regular supervisory polling response, the detector only needs to communicate with the loop controller when it has something new to report.

Accessories

Detector mounting bases have wiring terminals that are accessible from the "room-side" after mounting the base to the electrical box. The bases mount to North American 1-gang boxes and to 3½ inch or 4 inch octagon boxes, 1½ inches (38 mm) deep. They also mount to European BESA and 1-gang boxes with 60.3 mm fixing centers. The SIGA-SB4, SIGA-RB4, and SIGA-IB4 mount to North American 4 inch sq. electrical boxes in addition to the above boxes. They include the SIGA-TS4 Trim Skirt, which is used to cover the "mounting ears" on the base. The SIGA-AB4G mounts to a 4 inch square box only.



SIGA-AB4G/T/LF Audible Base | **SIGA-SB** Standard Base | **SIGA-IB** Isolator Base | **SIGA-RB** Relay Base | **SIGA-LED** Remote LED

Remote LED SIGA-LED - The remote LED connects to the SIGA-SB or SIGA-SB4 Standard Base only. It features a North American size 1-gang plastic faceplate with a white finish and red alarm LED.

SIGA-TS4 Trim Skirt - Supplied with 4 inch bases, it can also be ordered separately to use with the other bases to help hide surface imperfections not covered by the smaller bases.

Sounder Bases - Signature Series sounder bases are designed for use where localized or group alarm signaling is required.

- **SIGA-AB4G** bases provide sounder capability to Signature Series to heat and smoke detectors. They are not intended for use with combination carbon monoxide detectors in Fireplus-CO mode.
- **SIGA-AB4GT** bases provide sounder capability to Signature Series smoke and heat detectors, as well as carbon monoxide detectors when used with a SIGA-TCDR Temporal Pattern Generator.
- **SIGA-AB4G-LF** bases provide 520 Hz low frequency sounder capability to Signature Series smoke and heat detectors, as well as carbon monoxide detectors when used with a SIGA-TCDR Temporal Pattern Generator. The SIGA-AB4G-LF is suitable for applications requiring low frequency audible tones.

Warnings & Cautions

- This detector does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with the local fire protection specialist.
- This detector does not sense fires in areas where heat cannot reach the detector. Heat from fires in walls, roofs, or on the opposite side of closed doors may not reach the detector.
- This heat detector by itself does not provide life safety protection Use this detector with ionization and/or photoelectric smoke detectors.
- This detector does not detect oxygen levels, smoke, toxic gases, or flames. Use this device as part of a broad-based life safety program which includes a variety of information sources pertaining to heat and smoke levels, extinguishment systems, visual and audible devices, and other safety measures.
- Independent studies indicate that heat detectors should only be used when property protection alone is involved. Never rely on heat detectors as the sole means of fire protection.

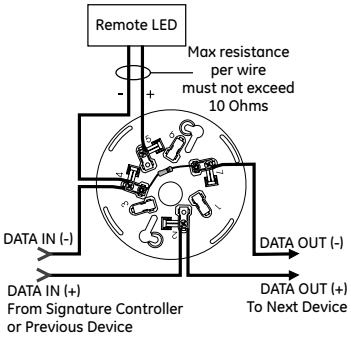
Typical Wiring

The detector mounting bases accept #18 AWG (0.75mm^2), #16 (1.0mm^2), #14 AWG (1.5mm^2), and #12 AWG (2.5mm^2) wire sizes. Sizes #16 AWG (1.0mm^2) and #18 AWG (0.75mm^2) are preferred for ease of installation.

Standard Detector Base, SIGA-SB, SIGA-SB4

This is the basic mounting base for EDWARDS Signature Series detectors. The SIGA-LED Remote LED is supported by this Base.

Term	Description
1	Not Used
2	DATA IN/OUT (+)
3	Not Used
4	DATA IN (-)
4	Remote LED (-)
5	Remote LED (+)
6	Not Used
7	DATA OUT (-)



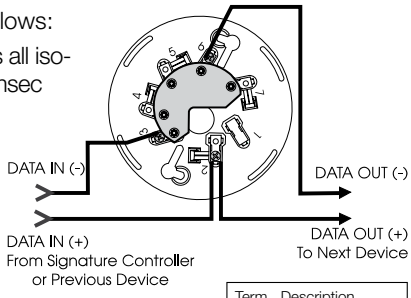
Isolator Detector Base, SIGA-IB, SIGA-IB4

This base includes a built-in line fault isolator for use on Class A circuits. A detector must be installed for it to operate. The isolator base does not support the SIGA-LED Remote LED.

The isolator operates as follows:

- a short on the line causes all isolators to open within 23 msec
- at 10 msec intervals, beginning on one side of the Class A circuit nearest the loop controller, the isolators close to provide the next isolator down the line with power
- when the isolator next to the short closes, it reopens within 10 msec.

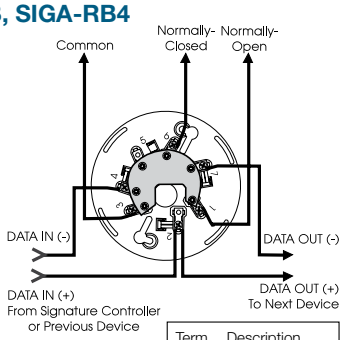
The process repeats beginning on the other side of the loop controller.



Term	Description
1	Not Used
2	DATA IN/OUT (+)
3	DATA IN (-)
4	Not Used
5	Not Used
6	DATA OUT (-)
7	Not Used

Relay Detector Base, SIGA-RB, SIGA-RB4

This base includes a relay. Normally Open or Normally Closed operation is selected during installation. The dry contact is rated for 1 amp (pilot duty) @ 30 Vdc. The relay's position is supervised to avoid accidentally jarring it out of position. The SIGA-RB can be operated as a control relay if programmed to do so at the control panel. The relay base does not support the SIGA-LED Remote LED.

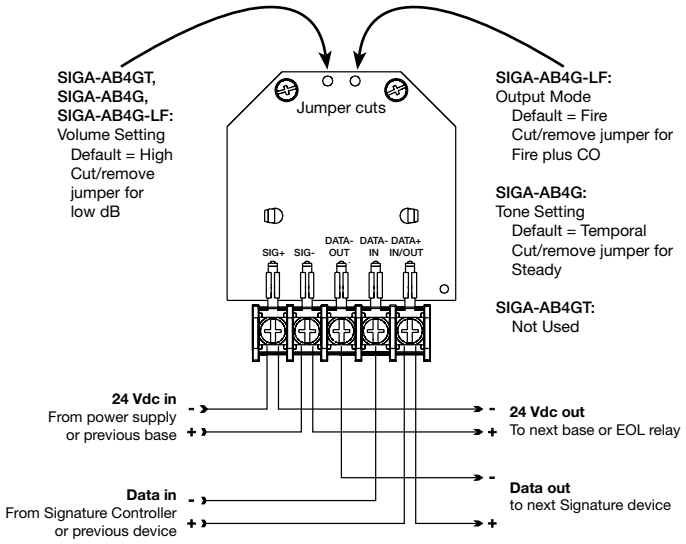


CONTACT RATING
1.0 Amp @ 30 VDC
(Pilot Duty)

Term	Description
1	Normally Open
2	DATA IN/OUT (+)
3	Common
4	DATA IN (-)
5	Not Used
6	Normally-Closed
7	DATA OUT (-)

Audible Sounder Bases, Fire Mode

AB4GT, AB4G, AB4G-LF sounder bases



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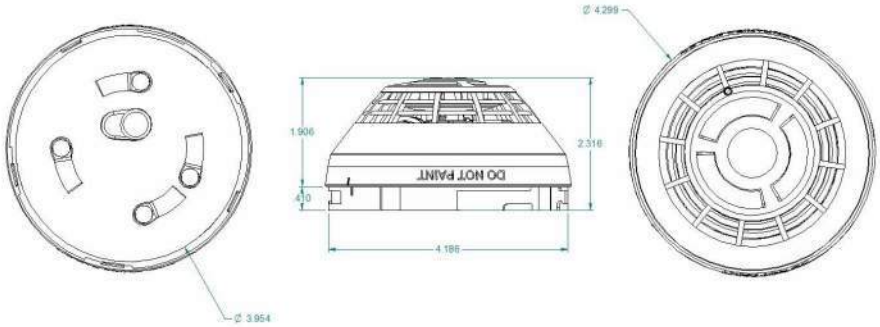
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Dimensions



Specifications

	SIGA- HRD	SIGA-HFD
Operating voltage	15.20 to 19.95 VDC	
Normal operating current	32 µA	
Alarm current	32 µA	
Vibration level	10 to 35 Hz, with an amplitude of 0.01 in.	
Rate-of-rise rating	15°F/min (8°C/min)	NA
Fixed temperature rating	135°F (57.2°C). Actual alarm point 129 to 141°F (53.9 to 60.6°C).	
Maximum spacing	50 ft. (15.2 m) centers	
Compatible bases	See Ordering Information	
Compatible detector testers	Testifire 1000, Testifire 2000	Testifire 2000
Operating environment	32 to 100°F (0 to 38°C), 0 to 93% RH, noncondensing	
Construction	High Impact Engineering Polymer, White	
Storage temperature	-4 to 140°F (-20 to 60°C)	
Agency Listings	CAN/ULC-S530, UL 521	CAN/ULC-S530-M91, UL 521

Ordering Information

Catalog Number	Description	Ship Wt. lbs (kg)
SIGA-HRD	Intelligent fixed temperature/Rate-of-rise heat detector	0.4 (0.16)
SIGA-HFD	Intelligent fixed temperature heat detector	

Compatible Bases		
SIGA-SB	Detector Mounting Base - Standard	0.2 (.09)
SIGA-SB4	4-inch Detector Mounting Base c/w Trim Skirt	
SIGA-RB	Detector Mounting Base w/Relay	
SIGA-RB4	4-inch Detector Mounting Base w/Relay, c/w Trim Skirt	
SIGA-IB	Detector Mounting Base w/Fault Isolator	
SIGA-IB4	4-inch Detector Mounting Base w/ Fault Isolator, c/w Trim Skirt	
SIGA-AB4G	Audible (Sounder) Base for Fire Detectors	0.3 (0.15)
SIGA-AB4G-LF	Low Frequency Audible (Sounder) Base for CO and Fire Detectors	
SIGA-AB4GT	Audible (Sounder) Base for CO and Fire Detectors	
SIGA-LED	Remote Alarm LED (not for EN54 applications)	
SIGA-TS4	Trim Skirt (supplied with 4-inch bases)	0.1 (0.04)
SIGA-TS	Trim Skirt (optional for non 4-inch bases)	
SIGA-RTA	Detector Removal Tool	

LIFE SAFETY & INCIDENT MANAGEMENT

Intelligent Smoke Detector

SIGA-OSD



Helps Reduce Cooking Nuisance Alarms
UL 268 7th Ed.

7272-1657: 0511

Overview

The Signature Optica Series SIGA-OSD smoke detector brings advanced optical (photoelectric) technology to a practical design that increases efficiency, saves installation time, cuts costs, and extends life safety and property protection capabilities. Continuous self-diagnostics ensure reliability over the long-haul, while environmental compensation helps reduce maintenance costs.

Like all Signature Optica Series detectors, the SIGA-OSD is an intelligent device that gathers analog information from multiple optical sensors, converting this data into digital signals. Utilizing dual optical wavelengths combined with multiple detection angles, the SIGA-OSD differentiates particles that are not representative of actual smoke. Particle data is input into digital filters which feed a series of ratios removing signal patterns that are typical of nuisance sources, thus reducing unwanted alarms. To make an alarm decision, the detector's on-board microprocessor measures and analyzes all optical sensor readings and compares this information to preprogrammed settings.

Standard Features

- Multi-criteria optical smoke sensing technology
- Wide 0.5 to 4.36 %/ft. (1.6 to 13.6 %/m) smoke obscuration
- Uses Existing Wiring
- Integrated nuisance rejection reducing unwanted alarms from general cooking particulates
- Listed to UL 268 7th edition
- Automatic Device Mapping
- Up To 250 Total Signature Addresses Per Loop
- Two Levels of Environmental Compensation
- Two Levels of Dirty Detector Warning
- Twenty Pre-Alarm Settings
- Five Sensitivity Settings
- Non-Volatile Memory
- Electronic Addressing
- Automatic Day/Night Sensitivity Adjustment
- Bicolor (Green/Red) Status LED
- Standard, Relay, Fault Isolator, and Audible Mounting Bases
- Sensor Markings Provide Easy Testing Identification

Note: Some features described here may not be supported by all control systems. Check your control panel's Installation and Operation Guide for details.

Application

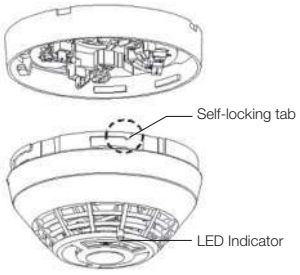
The SIGA-OSD detects particles from a wide range of combustion sources and will trigger an alarm when smoke density in the chamber reaches preprogrammed level. Thanks to its high-performance reflective response technology, the smoke sensor responds quickly and reliably to a wide range of fire types, including both fast and slow burning fires fueled by combustibles typically found in modern multi-use buildings.

Compatibility

The SIGA-OSD detector is compatible only with control panels using a Signature Loop controller.

Installation

Signature Series detectors mount to North American 1-gang boxes, 3-1/2 inch or 4 inch octagon boxes, and to 4 inch square electrical boxes 1-1/2 inches (38 mm) deep. They mount to European BESA and 1-gang boxes with 60.3 mm fixing centers. See mounting base installation and wiring for more information.



Sensing and reporting technology

The microprocessor in each detector provides additional benefits – Self-diagnostics and History Log, Automatic Device Mapping, and Fast, Stable Communication.

Self-diagnostics and History Log - Each Signature Series detector constantly runs self-checks to provide important maintenance information. The results of the self-check are automatically updated and permanently stored in the detector's non-volatile memory

Automatic Device Mapping - The loop controller learns where each device's serial number address is installed relative to other devices on the circuit. The mapping feature provides supervision of each device's installed location to prevent a detector from being reinstalled (after cleaning, etc.) in a different location from where it was originally.

Fast Stable Communication - On-board intelligence means less information needs to be sent between the detector and the loop controller. Other than regular supervisory polling response, the detector only needs to communicate with the loop controller when it has something new to report.

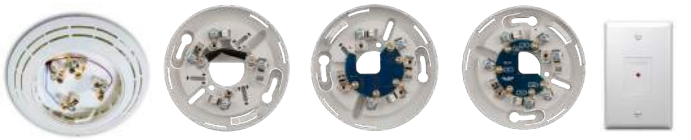
Testing & Maintenance

Each detector automatically identifies when it is dirty or defective and causes a "dirty detector" message. The detector's sensitivity measurement can also be transmitted to the loop controller. A sensitivity report may be printed to satisfy NFPA sensitivity measurements, which must be conducted at the end of the first year and every two years thereafter.

The user-friendly maintenance program shows the current state of each detector and other pertinent messages. Single detectors may be turned off temporarily from the control panel. Availability of maintenance features is dependent on the fire alarm system used.

Accessories

Detector mounting bases have wiring terminals that are accessible from the "room-side" after mounting the base to the electrical box. The bases mount to North American 1-gang boxes and to 3½ inch or 4 inch octagon boxes, 1½ inches (38 mm) deep. They also mount to European BESA and 1-gang boxes with 60.3 mm fixing centers. The SIGA-SB4, SIGA-RB4, and SIGA-IB4 mount to North American 4 inch sq. electrical boxes in addition to the above boxes. They include the SIGA-TS4 Trim Skirt, which is used to cover the "mounting ears" on the base. The SIGA-AB4G mounts to a 4 inch square box only.



SIGA-AB4G/T/LF	SIGA-SB	SIGA-IB	SIGA-RB	SIGA-LED
Audible Base	Standard Base	Isolator Base	Relay Base	Remote LED

Remote LED SIGA-LED - The remote LED connects to the SIGA-SB or SIGA-SB4 Standard Base only. It features a North American size 1-gang plastic faceplate with a white finish and red alarm LED.

SIGA-TS4 Trim Skirt - Supplied with 4 inch bases, it can also be ordered separately to use with the other bases to help hide surface imperfections not covered by the smaller bases.

Sounder Bases - Signature Series sounder bases are designed for use where localized or group alarm signaling is required.

- **SIGA-AB4G** bases provide sounder capability to Signature Series to heat and smoke detectors. They are not intended for use with combination carbon monoxide detectors in Fire-plus-CO mode.
- **SIGA-AB4GT** bases provide sounder capability to Signature Series smoke and heat detectors, as well as carbon monoxide detectors when used with a SIGA-TCDR Temporal Pattern Generator.
- **SIGA-AB4G-LF** bases provide 520 Hz low frequency sounder capability to Signature Series smoke and heat detectors, as well as carbon monoxide detectors when used with a SIGA-TCDR Temporal Pattern Generator. The SIGA-AB4G-LF is suitable for applications requiring low frequency audible tones.

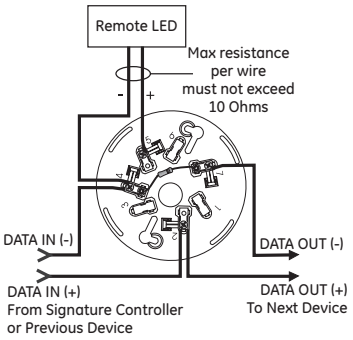
Typical Wiring

The detector mounting bases accept #18 AWG (0.75mm^2), #16 (1.0mm^2), #14 AWG (1.5mm^2), and #12 AWG (2.5mm^2) wire sizes. Sizes #16 AWG (1.0mm^2) and #18 AWG (0.75mm^2) are preferred for ease of installation.

Standard Detector Base, SIGA-SB, SIGA-SB4

This is the basic mounting base for EDWARDS Signature Series detectors. The SIGA-LED Remote LED is supported by this Base.

Term	Description
1	Not Used
2	DATA IN/OUT (+)
3	Not Used
4	DATA IN (-)
4	Remote LED (-)
5	Remote LED (+)
6	Not Used
7	DATA OUT (-)



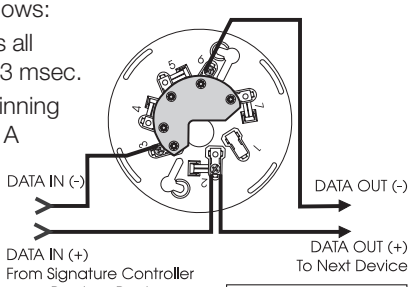
Isolator Detector Base, SIGA-IB, SIGA-IB4

This base includes a built-in line fault isolator for use on Class A circuits. A detector must be installed for it to operate. The isolator base does not support the SIGA-LED Remote LED.

The isolator operates as follows:

- a short on the line causes all isolators to open within 23 msec.
- at 10 msec intervals,beginning on one side of the Class A circuit nearest the loop controller, the isolators close to provide the next isolator down the line with power.
- when the isolator next to the short closes, it reopens within 10 msec.

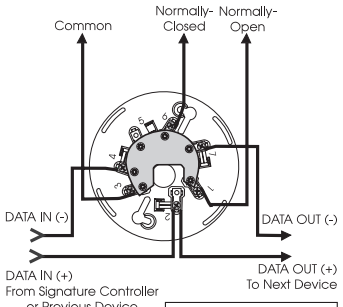
The process repeats beginning on the other side of the loop controller.



Term	Description
1	Not Used
2	DATA IN/OUT (+)
3	DATA IN (-)
4	Not Used
5	Not Used
6	DATA OUT (-)
7	Not Used

Relay Detector Base, SIGA-RB, SIGA-RB4

This base includes a relay. Normally Open or Normally Closed operation is selected during installation. The dry contact is rated for 1 amp (pilot duty) @ 30 Vdc. The relay's position is supervised to avoid accidentally jarring it out of position. The SIGA-RB can be operated as a control relay if programmed to do so at the control panel. The relay base does not support the SIGA-LED Remote LED.

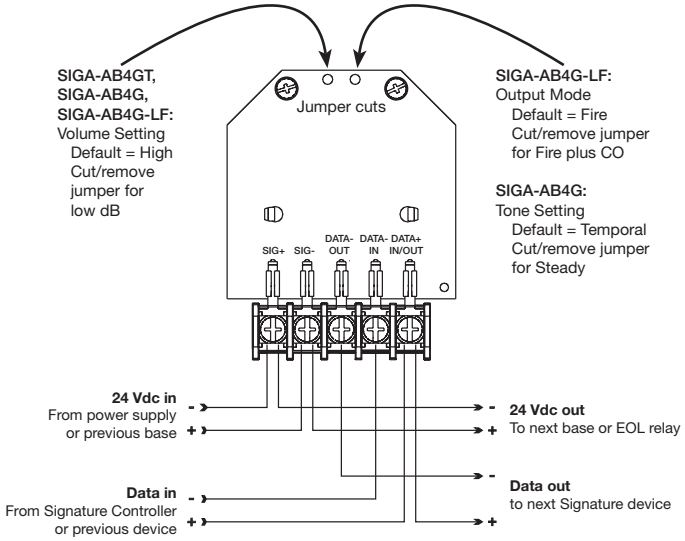


CONTACT RATING
1.0 Amp @ 30 VDC
(Pilot Duty)

Term	Description
1	Normally Open
2	DATA IN/OUT (+)
3	Common
4	DATA IN (-)
5	Not Used
6	Normally-Closed
7	DATA OUT (-)

Audible Sounder Bases, Fire Mode

AB4GT, AB4G, AB4G-LF sounder bases



Warnings & Cautions

- This detector does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with the local fire protection specialist.
- This detector does not sense fires in areas where smoke cannot reach the detector. Smoke from fires in walls, roofs, or on the opposite side of closed doors may not reach the detector.
- In Canada, install according to CAN/ULC-S524 Standard for the Installation of Fire Alarm Systems, CSA C22.1 Canadian Electrical Code, and the local authority having jurisdiction.

LIFE SAFETY & INCIDENT MANAGEMENT

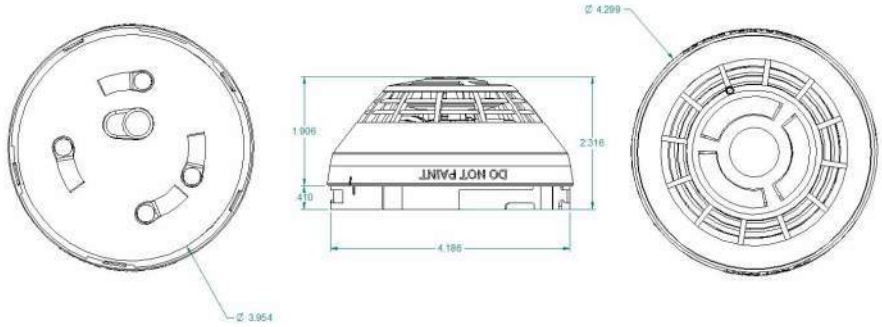
Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

8985 Town Center Pkwy
Bradenton, FL 34202

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Dimensions



Specifications

Operating voltage	15.20 to 19.95 VDC
Normal operating current	32 µA
Alarm current	45 µA
Smoke Sensitivity Range	UL/ULC: 0.5 to 4.36 %/ft. (1.6 to 13.6 %/m) obscuration
Vibration level	10 to 35 Hz, with an amplitude of 0.01 in.
Air velocity	0 to 4,000 ft./min (0 to 20 m/s)
Wall mounting	12 in. (305 mm) max. from ceiling
Compatible bases	See Ordering Information
Compatible detector testers	Testifire 1000, Testifire 2000
Operating environment	32 to 120°F (0 to 49°C), 0 to 93% RH, noncondensing
Construction	High Impact Engineering Polymer, White
Storage temperature	-4 to 140°F (-20 to 60°C)
Environmental compensation	Automatic
Agency Listings	CAN/ULC-S529, UL 268-7, UL 268A, CSFM

Ordering Information

Catalog Number	Description	Ship Wt. lbs (kg)
SIGA-OSD	Intelligent Optical Smoke Detector	0.4 (0.16)
Accessories		
SIGA-SB	Detector Mounting Base - Standard	
SIGA-SB4	4-inch Detector Mounting Base c/w Trim Skirt	
SIGA-RB	Detector Mounting Base w/Relay	
SIGA-RB4	4-inch Detector Mounting Base w/Relay, c/w Trim Skirt	0.2 (.09)
SIGA-IB	Detector Mounting Base w/Fault Isolator	
SIGA-IB4	4-inch Detector Mounting Base w/ Fault Isolator, c/w Trim Skirt	
SIGA-LED	Remote Alarm LED (not for EN54 applications)	
SIGA-AB4G	Audible (Sounder) Base for Fire Detectors	0.3 (0.15)
SIGA-AB4G-LF	Low Frequency Audible (Sounder) Base for CO and/or Fire Detectors	0.3 (0.15)
SIGA-AB4GT	Audible (Sounder) Base for CO and/or Fire Detectors	0.3 (0.15)
SIGA-TS4	Trim Skirt (supplied with 4-inch bases)	0.1 (0.04)
SIGA-TS	Trim Skirt - (optional for non 4-inch bases)	0.1 (0.04)
SIGA-DMP	Detector Mounting Plate	3.0 (1.4)
SIGA-RTA	Detector Removal Tool	
SIGA-VA	Detector Cleaning Tool	

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Wall Mount Speakers and Speaker-Strobes

Genesis LED G4S Series



c UL us
S218,
S5389

7320-1657:0516

FM
APPROVED

Overview

Genesis LED G4S Series speakers and speaker-strobes combine high performance output with a sleek low profile design and energy-efficient technology that makes them less expensive to install and operate. High performance LEDs require fewer power supplies, backup power, and batteries. These new appliances are designed with energy-efficiency, and life safety in mind.

Speakers feature selectable wattage taps, while speaker-strobes allow for both wattage and light output levels to be configured in the field. Both settings remain clearly visible — even after final installation. Speakers are also capable of both 25V and 70V and voltage in a single model with a field selectable switch. All this flexibility allows devices to be easily fine-tuned to exactly how they're needed to perform. All Genesis speakers include a DC blocking capacitor to allow electrical supervision of the audio distribution circuit.

Genesis LED G4S Series uses high efficiency optics, combined with patented electronics, to deliver a highly controlled and efficiently focused light distribution pattern in exchange for lower current requirements. Strobes feature field-selectable 15, 30,75, or 110 cd light output.

Compared with Xenon-type strobes, Genesis LED G4S Series appliances offer greatly reduced current draw which provides benefits in longer circuit lengths, more devices per circuit, smaller wire gauge and reduced power supply quantities for an installation. They are also backwards compatible with legacy strobes, so there's no need to replace all your existing devices to upgrade to new LED technology. In fact, G4S strobes can be mixed on the same circuit and used in the same field of view as Xenon-based strobes. This makes Genesis LED G4S Series ideal for new installations and retrofits alike.

Field-configurable sound output levels provide the flexibility modern life safety projects demand, while the Genesis LED control protocol keeps multiple strobes on compatible NAC circuits synchronized to well within NFPA 72 requirements. They also meet NFPA and UL 520Hz requirements for sleeping areas making them ideal for new construction or retrofits.

G4S Series speakers produce crisp, clear voice audio output that is highly intelligible over large areas. In an emergency, intelligibility is critical to life safety. Understanding the content of the message is as important as knowing there is an emergency. Intelligibility is measured in Speech Transmission Index and anything above .76 is considered excellent. G4S Series speakers deliver audio with an STI of .81 ensuring the message is clear.

Serviceability is another area where G4S Series appliances shine. The universal room side wiring plate allows for pre-installation and electrical wiring as well as checking continuity with the included diagnostics check bar. G4S Series devices can then be easily snapped into place with the confidence of knowing the wiring is correct. The innovative under-cover diagnostic test points provide easy access to device circuit testing while mounted.

Standard Features

- **High Fidelity performance with excellent STI**
  - Increased sound fidelity and audio intelligibility with an STI rating of .81 (More than .76 is excellent)
- **Low Frequency (520Hz) capable**
  - Low frequency output meets NFPA standards for newly constructed commercial sleeping areas
- **High Performance LED Strobe Technology**
  - Ultra low device current consumption allows:
    - More devices per circuit
    - Ability to use lower gauge wire
    - Longer wire runs
    - Fewer booster power supplies
  - High efficiency optics
  - Selectable 15, 30, 75, or 110 cd light output
  - LED devices may be mixed with legacy Xenon strobes on the same circuit and in the same field of view
- **Field flexibility**
  - Speakers are also capable of both 25V and 70V and voltage in a single model with a field selectable switch
  - Speakers feature selectable wattage taps for ¼W, ½W, 1W, and 2W to configure sound output levels in the field
- **Low-profile Design**
  - Ultra-slim... protrudes about 1.5" from the mounting surface
  - Attractive appearance... no visible mounting screws
- **Multiple "FIRE" Marking Options**
  - Order English, French, Spanish or no FIRE markings
  - Change markings at any time with replaceable quick-swap covers
- **Easy to Install**
  - Pre-install and pre-wire with convenient universal room side wiring plate
  - Check electrical continuity on room side wiring plate with included diagnostics check bar
  - Diagnostics port streamlines device circuit testing
  - Fits 2-gang and 4-inch square electrical boxes
  - Optional red and white trim plates available
  - Slide switches for field configuration
  - 12 to 18 AWG in-out screw terminals for quick wiring
- **Current draw is the same for all candela output settings**
  - Easier for new system design
  - Flexible for future changes in light output needs

Application

Strobes

Genesis G4S Series strobes are UL 1971-listed for use indoors as wall-mounted public-mode notification appliances for the hearing impaired. Prevailing codes require strobes to be used where ambient noise conditions exceed 105 dBA (87 dBA in Canada), where occupants use hearing protection, and in areas of public accommodation as defined in the Americans with Disabilities Act.

Synchronization is important in order to avoid triggering seizures in people with photosensitive epilepsy. All Genesis strobes exceed UL synchronization requirements (within 10 milliseconds over a two-hour period) when used with a synchronization source. See the specifications table for a list of compatible sources.

Speakers

The suggested sound pressure level for each signaling zone used with alert or alarm signals is a minimum of 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater. This is measured 5 feet (1.5 m) above the floor.

Doubling the distance from the signal to the ear will theoretically cause a 6 dB reduction in the received sound pressure level. The actual effect depends on the acoustic properties of materials in the space. Doubling the power output of a device (e.g.: a speaker from 1W to 2W) will increase the sound pressure level by 3dBA.

High Fidelity Sound

Genesis LED G4S Series High Fidelity appliances feature 87dB of sound output along with a highly intelligible Speech Transmission Index (STI) rating of .81. An STI rating above .76 is considered excellent for speech intelligibility They are also effective in areas subject to high levels of ambient noise.

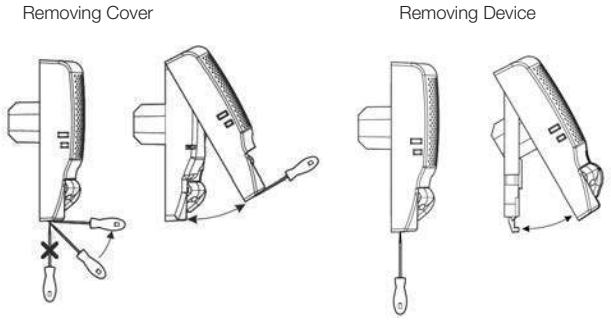
These appliances are ideal for hotels, dormitories and other residential occupancies that have sleeping areas that require 520Hz tones. In sleeping areas, always ensure that the wattage tap of the speaker is set sufficiently high so that the sound pressure reaches at least 75 dBA at the pillow.

These appliances are part of an end-to-end audio system approved for use in sleeping areas when used in conjunction with approved audio hardware and a factory-supplied 520 Hz tone. Check the System Compatibility List for other 520 Hz signaling requirements.

Installation

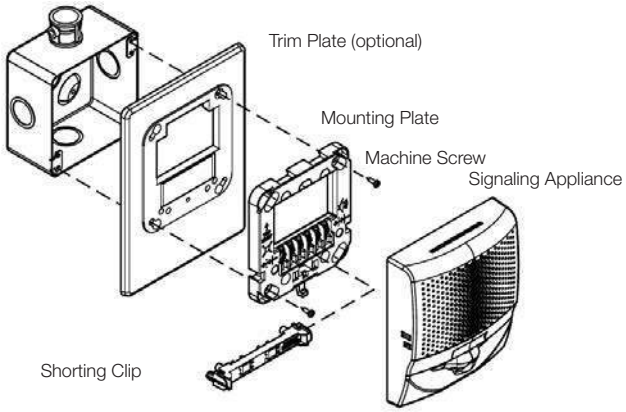
Genesis G4S speakers and speaker-strobes mount to the required GRSW room side wiring plate. The GRSW mounting plate is ordered separately from the G4S device in packs of 10 (GRSW-10) for convenient pre-installing and pre-wiring. The device can be removed easily from the room side wiring plate by pushing up with a screwdriver. The cover can also be removed from the device easily with a screwdriver to access the light and sound output settings and a diagnostics test port for voltage testing.

Genesis LED G4S Series speakers and speaker-strobes mount to any standard two-gang and 4-inch square electrical box. Matching optional G4T trim rings are available to cover oversized openings. Optional color matched double-gang surface boxes are also available.

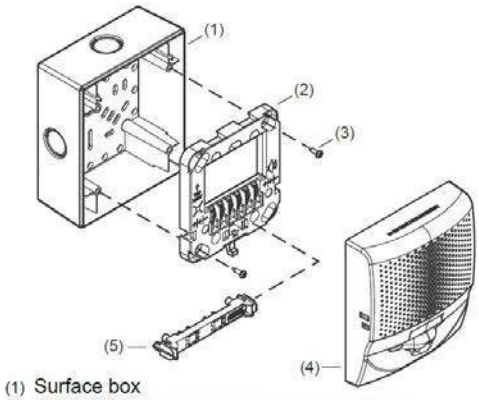


Installation

Electrical Box



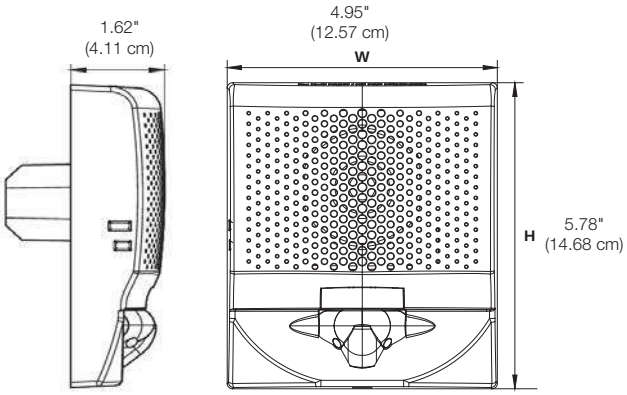
Surface Mount Box



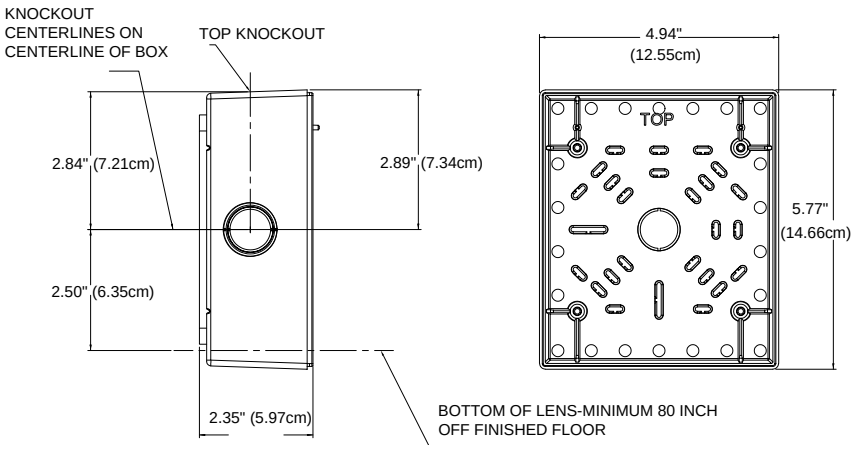
(1) Surface box
(2) Wiring plate (required, ordered separately)
(3) Machine screw (2X, supplied with wiring plate)
(4) Notification appliance
(5) Shorting clip

Dimensions

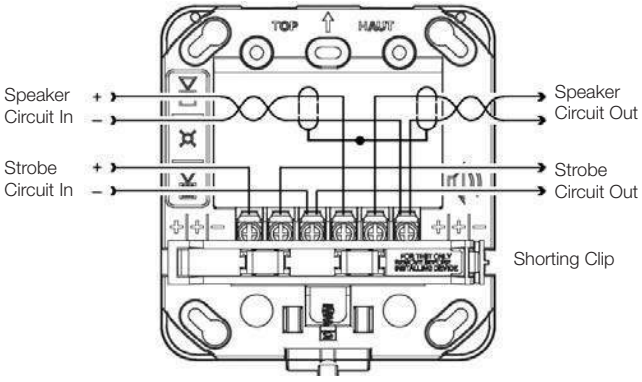
G4S Notification Appliances



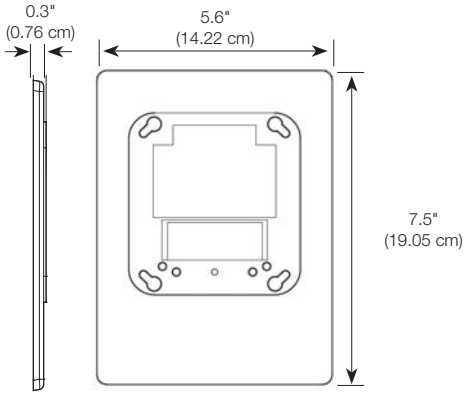
Surface Mount Box



Wiring



G4T Trim Plate (optional)



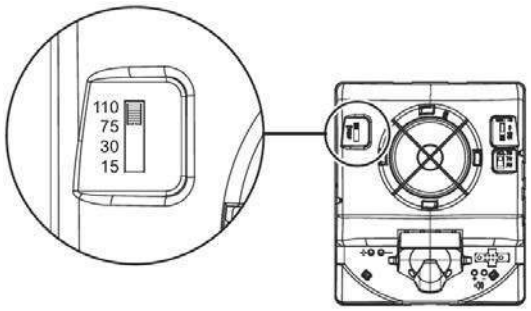
Field Configuration

Genesis LED speakers are capable of both 25V and 70V operation depending on the system, The voltage is set via a switch under the cover. Speakers also may be set for ¼, ½, 1, or 2 watt operation. The wattage setting is visible through a small window on the side of the device and is changed by simply sliding the switch under the cover until the desired setting appears in the window. The speaker does not have to be removed to change the wattage, only the cover skin.

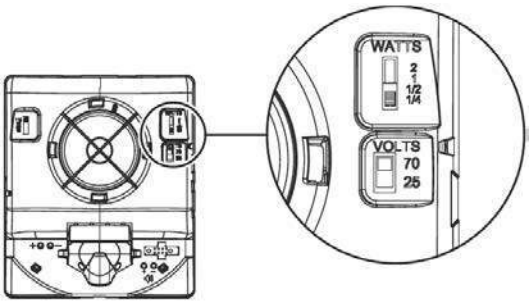
Genesis LED clear strobes and speaker-strobes may be set for 15, 30, 75, or 110 candela output. The output setting is changed by simply removing the cover and sliding the candela switch to the desired setting. The device does not have to be removed from the wall to change the output setting. The setting remains visible through a small window on the left-hand side of the device after the cover is closed.

Light and Sound Output Settings

Light Output Setting (Candela)



Sound Settings (Watts and Volts)

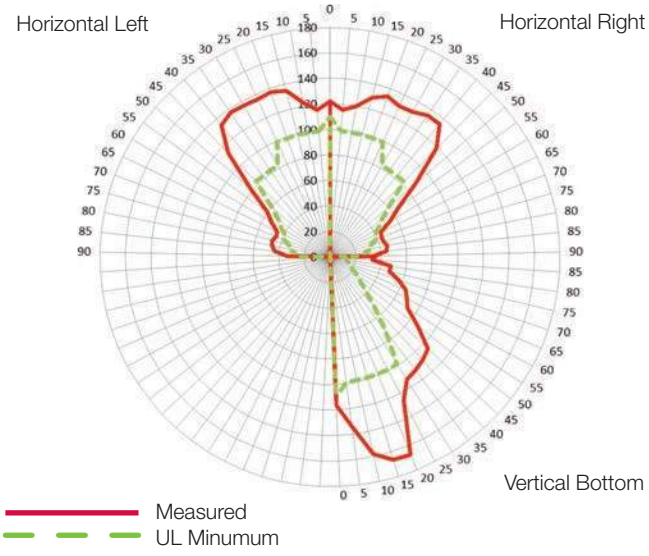


Sound Output

Sound pattern (ULC)

Axis	Angle	Change in output
Horizontal	117° and 61°	–3 dBA
	134° and 49°	–6 dBA
Vertical	128° and 68°	–3 dBA
	138° and 52°	–6 dBA

Light Distribution



Operating current

Strobes

Strobe setting	16 to 33 VDC	16 to 33 VFWR
15, 30, 75, 110	28 mA	36 mA

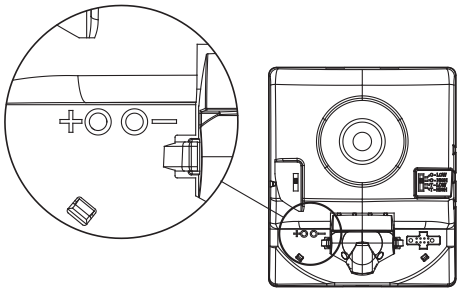
Note: Current draw is the same for all candela settings

Sound Level Output

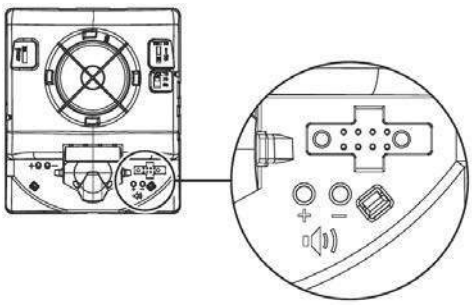
Voltage setting	Wattage setting	Reverberant (UL 1480)	Anechoic (CAN/ ULC-S541)
25V / 70V	¼W	78	78
	½W	81	81
	1W	84	84
	2W	87	87

Diagnostics

Strobe Circuit Test Points



Speaker Circuit Test Points



Test points indicated above are used to validate the Notification Appliance Circuit and verify device function.

Ordering Information

FOR REFERENCE ONLY

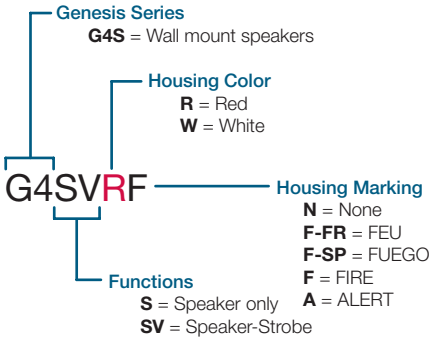
Notification Appliances		Color	Marking
 **Speakers**	G4SRF	Red	FIRE
	G4SRF-FR	Red	FEU
	G4SRF-SP	Red	FUEGO
	G4SRN	Red	None
	G4SWF	White	FIRE
	G4SWF-FR	White	FEU
	G4SWF-SP	White	FUEGO
	G4SWN	White	None
	G4SWA	White	Alert
 **Speaker-strobes**	G4SVRF	Red	FIRE
	G4SVRF-FR	Red	FEU
	G4SVRF-SP	Red	FUEGO
	G4SVRN	Red	None
	G4SVWF	White	FIRE
	G4SVWF-FR	White	FEU
	G4SVWF-SP	White	FUEGO
	G4SVWN	White	None
	G4SVWA	White	Alert

Replacement Appliance Covers		Color	Marking
 **Speakers**	G4SRA-CVR	Red	ALERT
	G4SRF-CVR	Red	FIRE
	G4SRF-FR-CVR	Red	FEU
	G4SRF-SP-CVR	Red	FUEGO
	G4SRN-CVR	Red	None
	G4SWA-CVR	White	ALERT
	G4SWF-CVR	White	FIRE
	G4SWF-FR-CVR	White	FEU
	G4SWF-SP-CVR	White	FUEGO
	G4SWN-CVR	White	None
 **Speaker-strobe Covers**	G4SVRA-CVR	Red	ALERT
	G4SVRF-CVR	Red	FIRE
	G4SVRF-FR-CVR	Red	FEU
	G4SVRF-SP-CVR	Red	FUEGO
	G4SVRN-CVR	Red	None
	G4SVWA-CVR	White	ALERT
	G4SVWF-CVR	White	FIRE
	G4SVWF-FR-CVR	White	FEU
	G4SVWF-SP-CVR	White	FUEGO
	G4SVWN-CVR	White	None

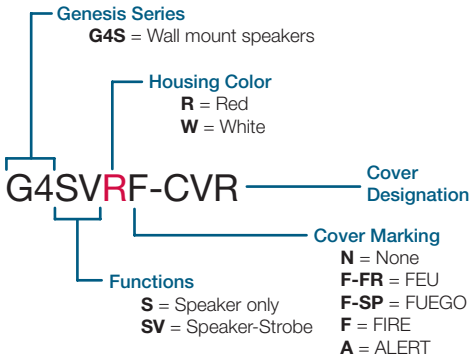
Accessories

	GRSW-10 Room Side Wiring Plate (required, ordered separately)		G4TR	Trim plate, G4 Series, red	 G4TW Trim plate, G4 Series, white
			G4RSB	Wall 4 inch Surface Mount Box, Red	 G4WSB Wall 4 inch Surface Mount Box, White

Model Number Syntax, Appliances



Model Number Syntax, Replacement Covers



LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

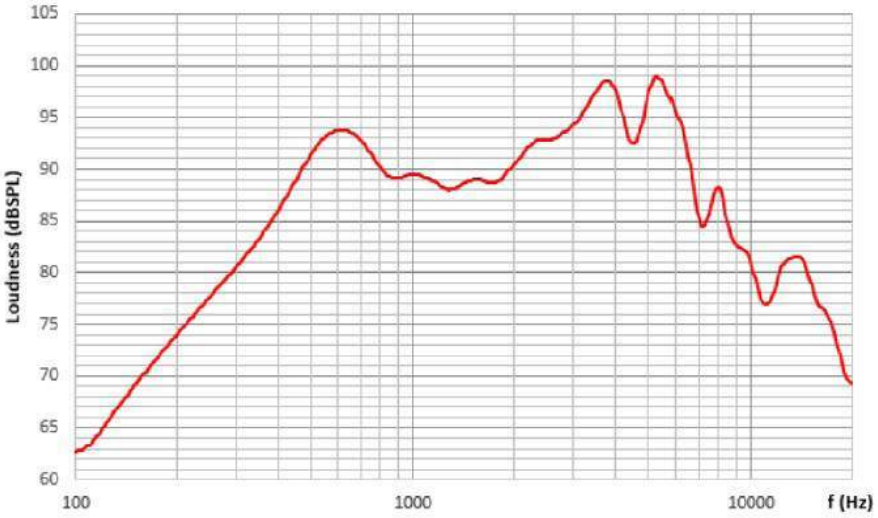
Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

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Bradenton, FL 34202

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Specifications

Strobe operating voltage	16 to 33 VDC, 16 to 33 VFWR
Speaker operating voltage	25VRMS of 70VRMS (selectable)
Speaker frequency response (UL rated)	400Hz-4,000Hz
Speaker frequency response (nominal)	100Hz-11,000Hz
Light output	15, 30, 75, or 110 candela
Strobe flash rate	1 fps (flash per second) approx.
Synchronization	20 Ω max. between any two devices. To determine allowed wire resistance, refer to these specifications, and the specifications for the synchronized signal source.
Synchronization Sources	Edwards CC Series Signal Modules, Booster and Auxiliary Power Supplies, Intelligent and Conventional Control Panels
Wire size	12 to 18 AWG (0.75 to 2.50 mm^2)
Dimensions (W×H×D)	4.95 x 5.78 x 1.62 in (12.57 x 14.68 x 4.11 cm)
Strobe-to-box center offset	-1.70 inches (-4.32 cm)
Compatible electrical boxes [1]	2-gang, 4-inch square
Trim plates	G4TR, G4TW (5.6 x 7.5 x 0.3 in (14.22 x 19.05 x 0.76 cm))
Operating environment Temperature Relative humidity	 32 to 122°F (0 to 50°C) 0 to 93% noncondensing
Storage Temperature	-40 to 158 F (-40 to 70 C)
Environmental compliance	RoHS directive 2011/65/EU



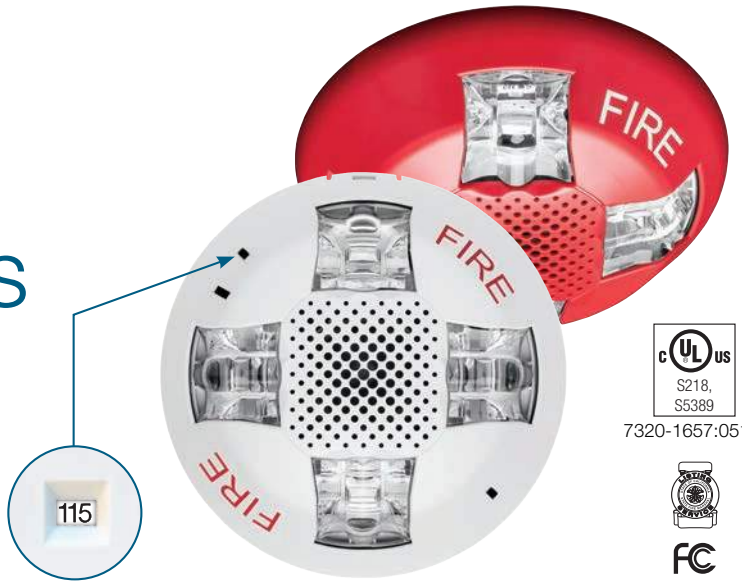
Typical Frequency response @ 1W/1m

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Ceiling Mount Speakers and Speaker-Strobes

Genesis LED GCS Series



cULus S218, S5389

7320-1657:0516

FM APPROVED

Overview

Genesis LED GCS Series speakers and speaker-strobes combine high performance output with a sleek low profile design and energy-efficient technology that makes them less expensive to install and operate. High performance LEDs require fewer power supplies, backup power, and batteries. These new appliances are designed with energy-efficiency, and life safety in mind.

Speakers feature selectable wattage taps, while speaker-strobes allow for both wattage and light output levels to be configured in the field. Both settings remain clearly visible — even after final installation. Speakers are also capable of both 25V and 70V and voltage in a single model with a field selectable switch. All this flexibility allows devices to be easily fine-tuned to exactly how they're needed to perform. All Genesis speakers include a DC blocking capacitor to allow electrical supervision of the audio distribution circuit.

Genesis LED GCS Series uses high efficiency optics, combined with patented electronics, to deliver a highly controlled and efficiently focused light distribution pattern in exchange for lower current requirements. Strobes feature field-selectable 15, 30,75, or 115 cd light output.

Compared with Xenon-type strobes, Genesis LED GCS Series appliances offer greatly reduced current draw which provides benefits in longer circuit lengths, more devices per circuit, smaller wire gauge and reduced power supply quantities for an installation. They are also backwards compatible with legacy strobes, so there's no need to replace all your existing devices to upgrade to new LED technology. In fact, GCS strobes can be mixed on the same circuit and used in the same field of view as Xenon-based strobes. This makes Genesis LED GCS Series ideal for new installations and retrofits alike.

Field-configurable sound output levels provide the flexibility modern life safety projects demand, while the Genesis LED control protocol keeps multiple strobes on compatible NAC circuits synchronized to well within NFPA 72 requirements. They also meet NFPA and UL 520Hz requirements for sleeping areas making them ideal for new construction or retrofits.

GCS Series speakers produce crisp, clear voice audio output that is highly intelligible over large areas. In an emergency, intelligibility is critical to life safety. Understanding the content of the message is as important as knowing there is an emergency. Intelligibility is measured in Speech Transmission Index and anything above .76 is considered excellent. GCS Series speakers deliver audio with an STI of .81 ensuring the message is clear.

Serviceability is another area where GCS Series appliances shine. The universal room side wiring plate allows for pre-installation and electrical wiring as well as checking continuity with the included diagnostics check bar. GCS Series devices can then be easily snapped into place with the confidence of knowing the wiring is correct. The innovative under-cover diagnostic test points provide easy access to device circuit testing while mounted.

Standard Features

- **High Fidelity performance with excellent STI**
  - Increased sound fidelity and audio intelligibility with an STI rating of .81 (More than .76 is excellent)
- **Low Frequency (520Hz) capable**
  - Low frequency output meets NFPA standards for newly constructed commercial sleeping areas
- **High Performance LED Strobe Technology**
  - Ultra low device current consumption allows:
    - More devices per circuit
    - Ability to use lower gauge wire
    - Longer wire runs
    - Fewer booster power supplies
  - High efficiency optics
  - Selectable 15, 30, 75, or 115 cd light output
  - LED devices may be mixed with legacy Xenon strobes on the same circuit and in the same field of view
- **Field flexibility**
  - Speakers are also capable of both 25V and 70V voltage in a single model with a field selectable switch
  - Speakers feature selectable wattage taps for ¼W, ½W, 1W, and 2W to configure sound output levels in the field
- **Low-profile Design**
  - Ultra-slim... protrudes about 1.5" from the mounting surface
  - Attractive appearance... no visible mounting screws
- **Multiple "FIRE" Marking Options**
  - Order English, French, Spanish or no FIRE markings
  - Change markings at any time with replaceable quick-swap covers
- **Easy to Install**
  - Pre-install and pre-wire with convenient universal room side wiring plate
  - Check electrical continuity on room side wiring plate with included diagnostics check bar
  - Diagnostics port streamlines device circuit testing
  - Fits 2-gang and 4-inch square electrical boxes
  - Optional red and white trim plates available
  - Slide switches for field configuration
  - 12 to 18 AWG in-out screw terminals for quick wiring
- **Current draw is the same for all candela output settings**
  - Easier for new system design
  - Flexible for future changes in light output needs

Application

Strobes

Genesis GCS Series strobes are UL 1971-listed for use indoors as wall or ceiling public-mode notification appliances for the hearing impaired. Prevailing codes require strobes to be used where ambient noise conditions exceed 105 dBA (87 dBA in Canada), where occupants use hearing protection, and in areas of public accommodation as defined in the Americans with Disabilities Act.

Synchronization is important in order to avoid triggering seizures in people with photosensitive epilepsy. All Genesis strobes exceed UL synchronization requirements (within 10 milliseconds over a two-hour period) when used with a synchronization source. See the specifications table for a list of compatible sources.

Speakers

The suggested sound pressure level for each signaling zone used with alert or alarm signals is a minimum of 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater. This is measured 5 feet (1.5 m) above the floor.

Doubling the distance from the signal to the ear will theoretically cause a 6 dB reduction in the received sound pressure level. The actual effect depends on the acoustic properties of materials in the space. Doubling the power output of a device (e.g.: a speaker from 1W to 2W) will increase the sound pressure level by 3dBA.

High Fidelity Sound

Genesis LED GCS Series High Fidelity appliances feature 87dB of sound output along with a highly intelligible Speech Transmission Index (STI) rating of .81. An STI rating above .76 is considered excellent for speech intelligibility They are also effective in areas subject to high levels of ambient noise.

These appliances are ideal for hotels, dormitories and other residential occupancies that have sleeping areas that require 520Hz tones. In sleeping areas, always ensure that the wattage tap of the speaker is set sufficiently high so that the sound pressure reaches at least 75 dBA at the pillow.

These appliances are part of an end-to-end audio system approved for use in sleeping areas when used in conjunction with approved audio hardware and a factory-supplied 520 Hz tone. Check the System Compatibility List for other 520 Hz signaling requirements.

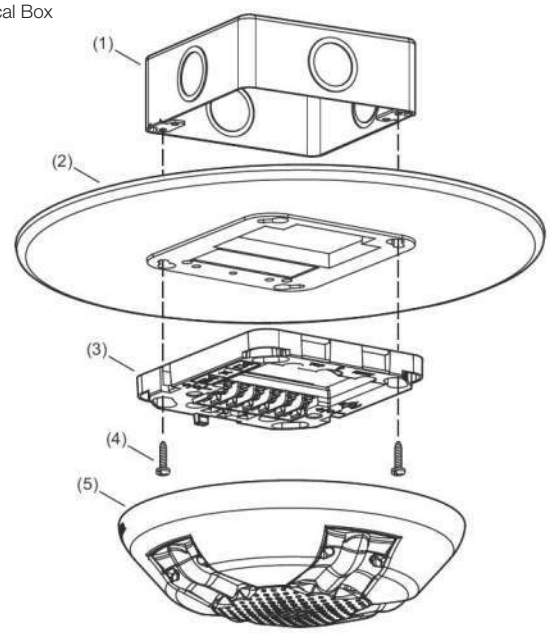
Installation

Genesis GCS speakers and speaker-strobes mount to the required GRSW room side wiring plate. The GRSW mounting plate is ordered separately from the GCS device in packs of 10 (GRSW-10) for convenient pre-installing and pre-wiring. The device can be removed easily from the room side wiring plate by pushing up with a screwdriver. The cover can also be removed from the device easily with a screwdriver to access the light and sound output settings and a diagnostics test port for voltage testing.

Genesis LED GCS Series speakers and speaker-strobes mount to any standard two-gang and 4-inch square electrical box. Matching optional GCT trim rings are available to cover oversized openings. Optional color matched double-gang surface boxes are also available.

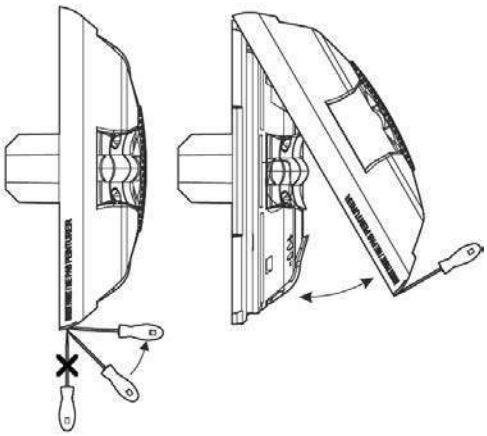
Installation

Electrical Box

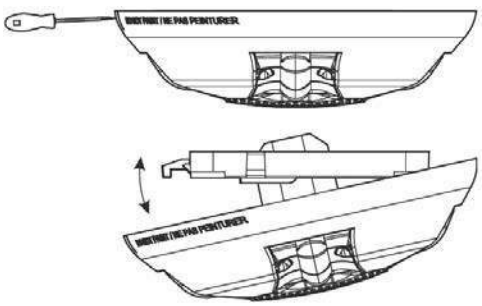


(1) Electrical box
(2) Trim plate (optional)
(3) Wiring plate (required, ordered separately)
(4) Machine screw (2X, supplied with wiring plate)
(5) Notification appliance

Removing Cover

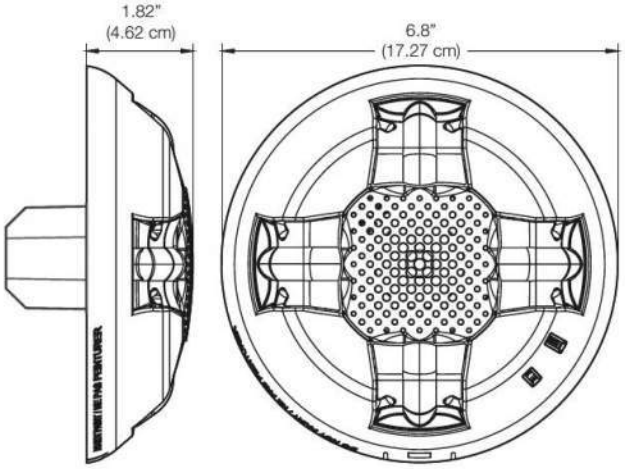


Removing Device

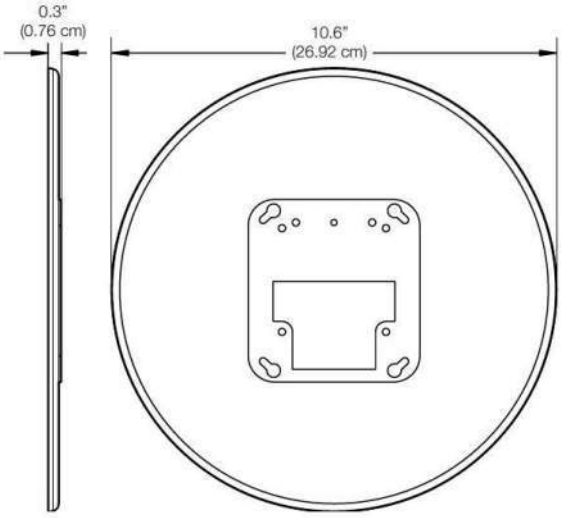


Dimensions

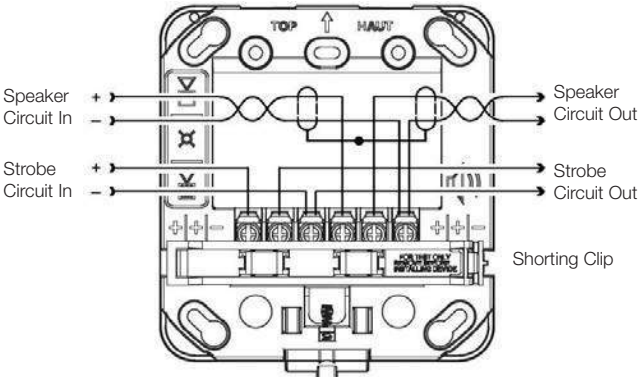
GCS Notification Appliances



GCT Trim Plate (optional)



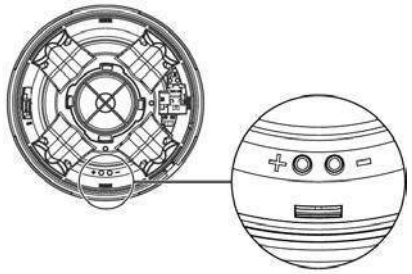
Wiring



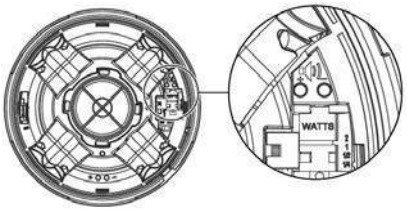
Test points indicated above are used to validate the Notification Appliance Circuit and verify device function.

Diagnostics

Strobe Circuit Test Points



Speaker Circuit Test Points



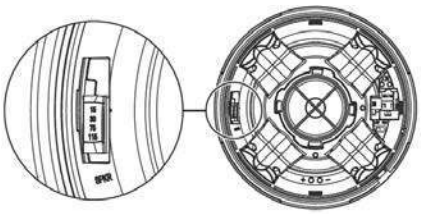
Field Configuration

Genesis LED speakers are capable of both 25V and 70V operation depending on the system, The voltage is set via a switch under the cover. Speakers also may be set for ¼, ½, 1, or 2 watt operation. The wattage setting is visible through a small window on the side of the device and is changed by simply sliding the switch under the cover until the desired setting appears in the window. The speaker does not have to be removed to change the wattage, only the cover skin.

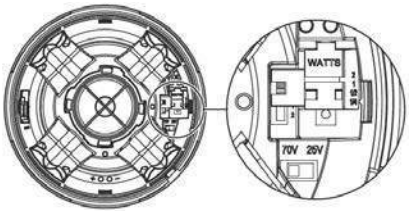
Genesis LED clear strobes and speaker-strobes may be set for 15, 30, 75, or 115 candela output. The output setting is changed by simply removing the cover and sliding the candela switch to the desired setting. The device does not have to be removed from the wall to change the output setting. The setting remains visible through a small window on the left-hand side of the device after the cover is closed.

Light and Sound Output Settings

Light Output Setting (Candela)



Sound Settings (Watts and Volts)



Operating current

Strobes

Strobe setting	16 to 33 VDC	16 to 33 VFWR
15, 30, 75, 115	35 mA	45 mA

Note: Current draw is the same for all candela settings

Sound Level Output

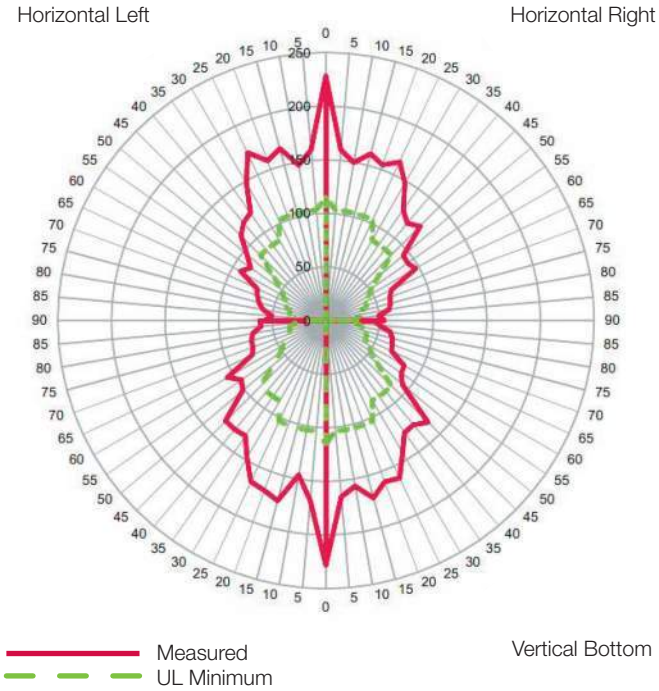
Voltage setting	Wattage setting	Reverberant (UL 1480)	Anechoic (CAN/ ULC-S541)
25V / 70V	¼W	78	77
	½W	81	80
	1W	84	83
	2W	87	86

Sound Output

Sound pattern (ULC)

Axis	Angle	Change in output
Horizontal	120° and 60°	–3 dBA
	140° and 40°	–6 dBA
Vertical	120° and 60°	–3 dBA
	145° and 40°	–6 dBA

Light Distribution



Ordering Information

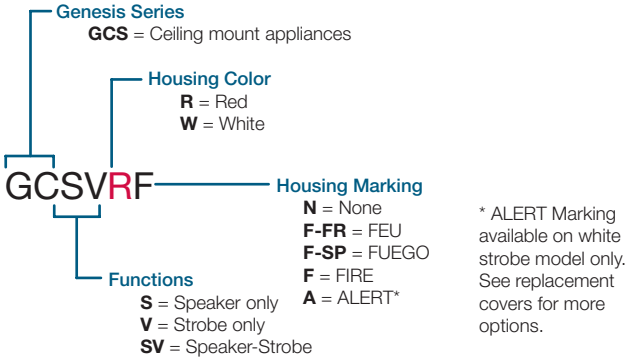
Notification Appliances		Color	Marking
 **Speakers**	GCSRF	Red	FIRE
	GCSRF-FR	Red	FEU
	GCSRF-SP	Red	FUEGO
	GCSRN	Red	None
	GCSWF	White	FIRE
	GCSWF-FR	White	FEU
	GCSWF-SP	White	FUEGO
	GCSWN	White	None
	GCSWA	White	ALERT
 **Speaker-strobes**	GCSVRF	Red	FIRE
	GCSVRF-FR	Red	FEU
	GCSVRF-SP	Red	FUEGO
	GCSVRN	Red	None
	GCSVWF	White	FIRE
	GCSVWF-FR	White	FEU
	GCSVWF-SP	White	FUEGO
	GCSVWN	White	None
	GCSVWA	White	ALERT

Replacement Appliance Covers		Color	Marking
 **Speaker Covers**	GCSRA-CVR	Red	ALERT
	GCSRF-CVR	Red	FIRE
	GCSRF-FR-CVR	Red	FEU
	GCSRF-SP-CVR	Red	FUEGO
	GCSRN-CVR	Red	None
	GCSWA-CVR	White	ALERT
	GCSWF-CVR	White	FIRE
	GCSWF-FR-CVR	White	FEU
	GCSWF-SP-CVR	White	FUEGO
	GCSWN-CVR	White	None
 **Speaker-strobe Covers**	GCSVRA-CVR	Red	ALERT
	GCSVRF-CVR	Red	FIRE
	GCSVRF-FR-CVR	Red	FEU
	GCSVRF-SP-CVR	Red	FUEGO
	GCSVRN-CVR	Red	None
	GCSVWA-CVR	White	ALERT
	GCSVWF-CVR	White	FIRE
	GCSVWF-FR-CVR	White	FEU
	GCSVWF-SP-CVR	White	FUEGO
	GCSVWN-CVR	White	None

Accessories

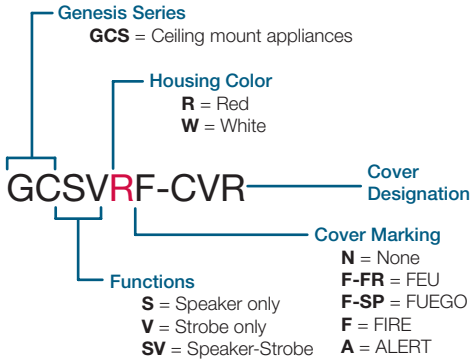
	GRSW-10	Room Side Wiring Plate 10 pack (required, ordered separately)	 GCTR	Trim plate, GC Series, red	 GCTW	Trim plate, GC Series, white
			27193-21	Two-gang surface mount box, red	27193-26	Two-gang surface mount box, white

Model Number Syntax, Appliances



* ALERT Marking available on white strobe model only. See replacement covers for more options.

Model Number Syntax, Replacement Covers



LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

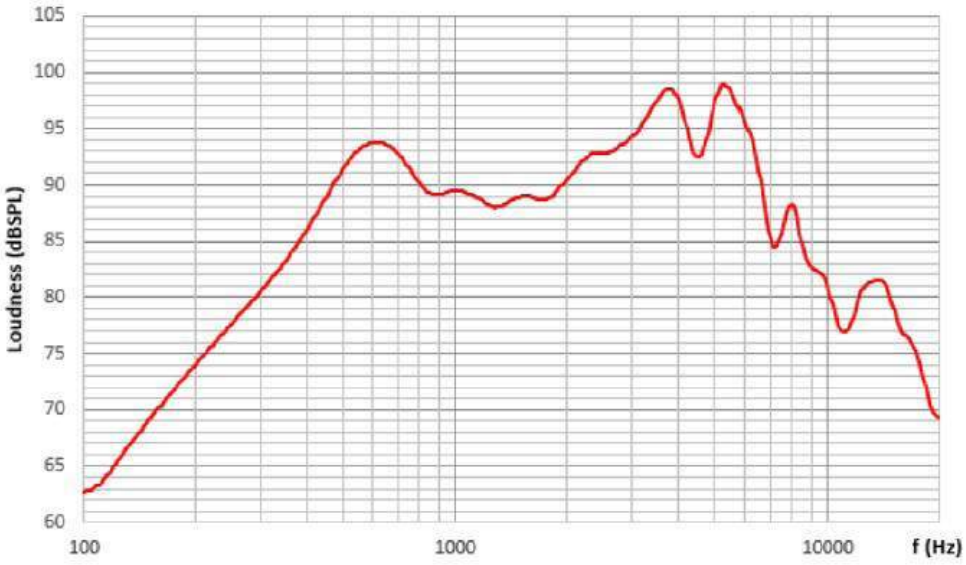
Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

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Specifications

Strobe operating voltage	16 to 33 VDC, 16 to 33 VFWR
Speaker operating voltage	25VRMS of 70VRMS (selectable)
Speaker frequency response (UL rated)	400Hz-4,000Hz
Speaker frequency response (nominal)	100Hz-11,000Hz
Light output	15, 30, 75, or 115 candela
Strobe flash rate	1 fps (flash per second) approx.
Synchronization	20 Ω max. between any two devices. To determine allowed wire resistance, refer to these specifications, and the specifications for the synchronized signal source.
Synchronization Sources	Edwards CC Series Signal Modules, Booster and Auxiliary Power Supplies, Intelligent and Conventional Control Panels
Wire size	12 to 18 AWG (0.75 to 2.50 mm^2)
Dimensions (Ø × D)	6.8 x 1.82 in (17.27 x 4.62 cm)
Strobe-to-box center offset	-1.70 inches (-4.32 cm)
Compatible electrical boxes [1]	2-gang, 4-inch square
Trim plates	GCTR, GCTW 10.6 × 0.3 in. (26.92 × 0.76 cm)
Operating environment Temperature Relative humidity	 32 to 122°F (0 to 50°C) 0 to 93% noncondensing
Storage Temperature	-40 to 158 F (-40 to 70 C)
RAL Color	Red=RAL 3013 White=RAL 9002
Environmental compliance	RoHS directive 2011/65/EU



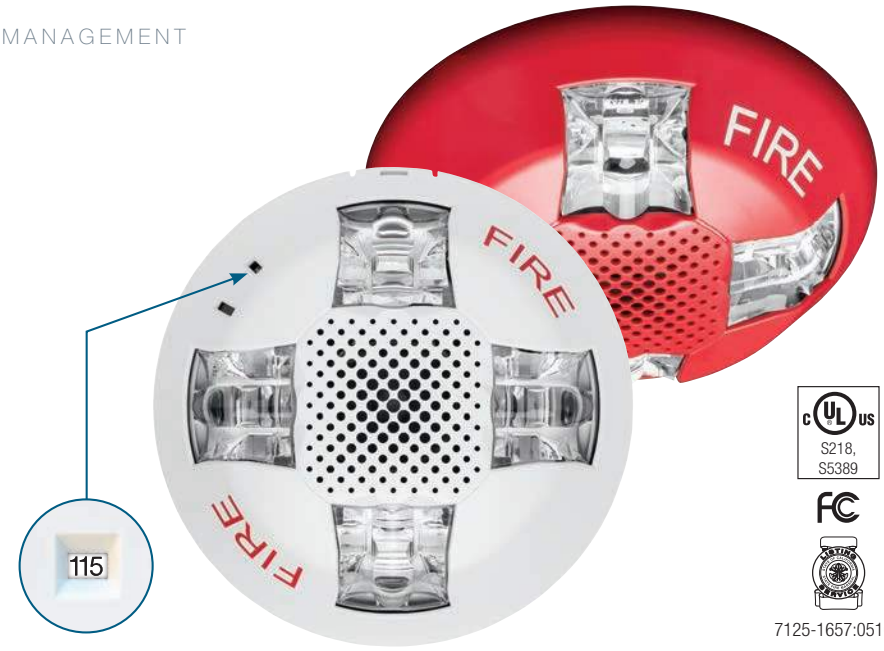
Typical Frequency response @ 1W/1m

EDWARDS

LIFE SAFETY & INCIDENT MANAGEMENT

Genesis LED GC Series

Ceiling Mount Notification Devices



c UL us S218, S5389

FC

7125-1657:0510

FM APPROVED

Overview

Genesis LED GC Series horns and LED strobes feature a sleek low profile design and energy-efficient technology that makes them less expensive to install and operate by reducing overhead. High performance LEDs require fewer power supplies, backup power, and batteries. These new appliances are designed with, energy-efficiency, and life safety in mind.

Genesis LED GC Series uses high efficiency optics, combined with patented electronics, to deliver a highly controlled and efficiently focused light distribution pattern in exchange for lower current requirements. Strobes feature field-selectable 15, 30,75, or 115 cd light output.

Compared with Xenon-type strobes, Genesis LED GC Series appliances need fewer power supplies and often smaller wire gauge, which lightens conduit requirements. They are also backwards compatible with legacy strobes, so there's no need to replace all your existing devices to upgrade to new LED technology. In fact, GC strobes can be mixed on the same circuit and used in the same field of view as Xenon-based strobes. This makes Genesis LED GC Series ideal for new installations and retrofits alike.

Field-configurable sound output levels provide the flexibility modern life safety projects demand, while the Genesis LED control protocol keeps multiple strobes on compatible NAC circuits synchronized to well within NFPA 72 requirements.

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Standard Features

- **High Performance LED Strobe Technology**
  - Ultra low device current consumption allows:
    - More devices per circuit
    - Ability to use lower gauge wire
    - Longer wire runs
    - Fewer booster power supplies
  - High efficiency optics
  - Selectable 15, 30, 75, or 115 cd light output
  - LED devices may be mixed with legacy Xenon strobes
- **Efficient Audible Output**
  - Selectable high or low dB horn output
  - Selectable temporal or steady horn output
  - Improved audio frequency range for better wall penetration
- **Low-profile Design**
  - Ultra-slim... protrudes about 1.5" from the mounting surface
  - Attractive appearance... no visible mounting screws
- **Multiple "FIRE" Marking Options**
  - Order English, French, Spanish or no FIRE markings
  - Change markings at any time with replaceable quick-swap covers
- **Easy to Install**
  - Pre-install and pre-wire with convenient universal room side wiring plate
  - Check electrical continuity on room side wiring plate with included diagnostics check bar
  - Diagnostics port streamlines device circuit testing
  - Fits 1-gang, 2-gang, 4-inch octagon, and 4-inch square electrical boxes
  - Optional red and white trim plates available
  - Slide switches for field configuration
  - 12 to 18 AWG in-out screw terminals for quick wiring

Application

Strobes

Genesis GC Series strobes are UL 1971-listed for use indoors as ceiling-mounted public-mode notification appliances for the hearing impaired. Prevailing codes require strobes to be used where ambient noise conditions exceed 105 dBA (87 dBA in Canada), where occupants use hearing protection, and in areas of public accommodation as defined in the *Americans with Disabilities Act*.

Synchronization is important in order to avoid triggering seizures in people with photosensitive epilepsy. All Genesis strobes exceed UL synchronization requirements (within 10 milliseconds over a two-hour period) when used with a synchronization source. See the specifications table for a list of compatible sources.

Horns

Genesis horn output reaches as high as 92 dBA and features an improved audio frequency range compared with other Genesis horns. This results in excellent sound penetration through walls and a clear warning of danger. Horn only models may be configured for either coded or non-coded notification appliance circuits. They can also be set for high or low dBA output. This setting reduces horn output by about 6 dBA.

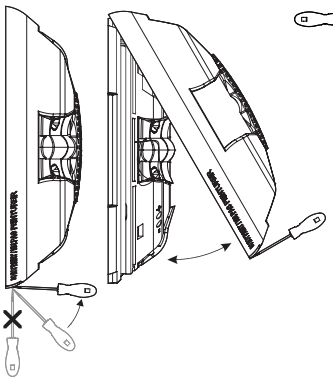
The suggested sound pressure level for each signaling zone used with alarm signals is at least 15 dBA above the average ambient sound level, or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater. These values are measured at five feet (1.5 m) above the floor. The average ambient sound level is A-weighted, fast response sound pressure measured over a 24-hour period.

Doubling the distance from the signal to the ear will theoretically result in a 6 dBA reduction of the received sound pressure level. The actual effect depends on the acoustic environment in the space. A 3 dBA difference represents a barely noticeable change in volume.

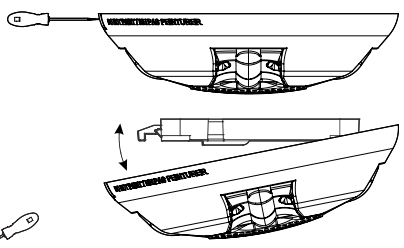
Installation

Genesis GC horns and strobes mount to the required GP10 room side wiring plate. The GP10 mounting plate is ordered separately from the GC device in packs of 10 for convenient pre-installing and pre-wiring. The device can be removed easily from the room side wiring plate by pushing up with a screwdriver. The cover can also be removed from the device easily with a screwdriver to access the light and sound output settings and a diagnostics test port for voltage testing.

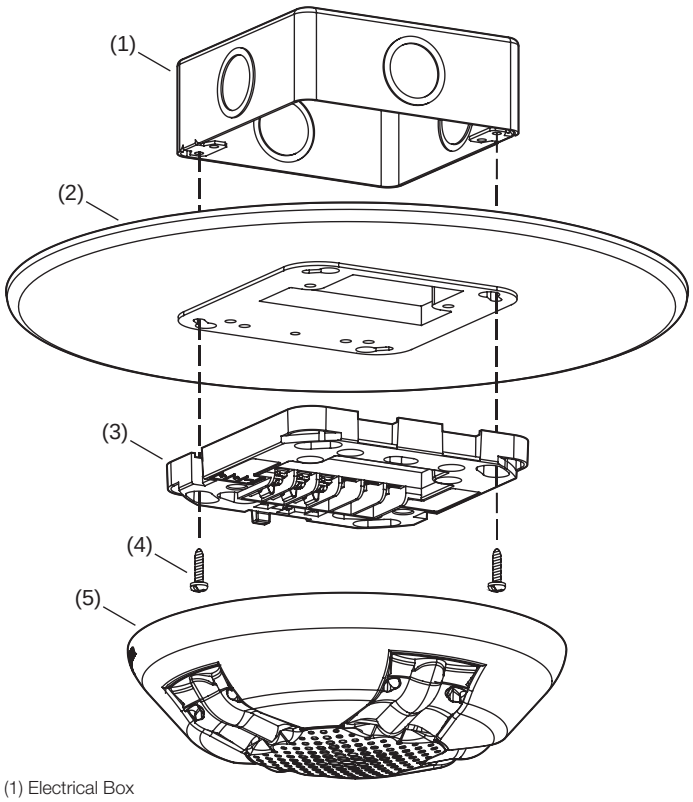
Removing Cover



Removing Device

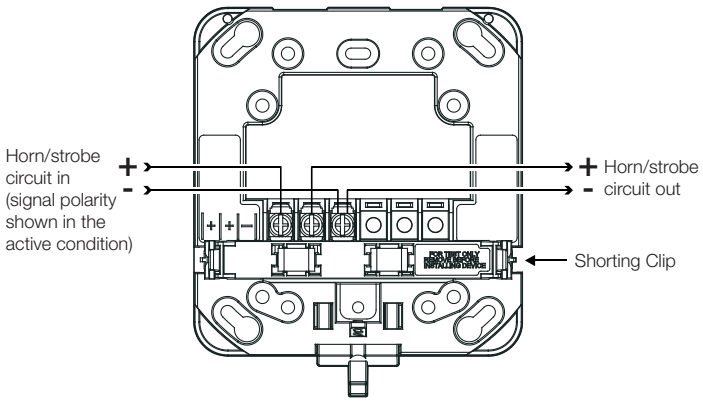


Genesis LED GC Series horns, strobes, and horn-strobes mount to any standard one-gang, two-gang, 4-inch octagon, and 4-inch square electrical box. Matching optional GCT trim rings are available to cover oversized openings. Optional color matched double-gang surface boxes are also available. Genesis LED GC series are listed to be both wall mounted or ceiling mounted.



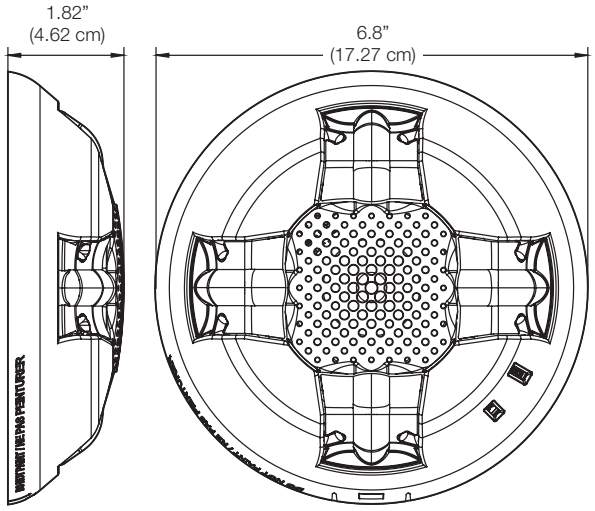
(1) Electrical Box
(2) Trim Plate (optional)
(3) Wiring plate (required, ordered separately)
(4) Machine screw (2X, supplied with wiring plate)
(5) GC signaling appliance

Wiring

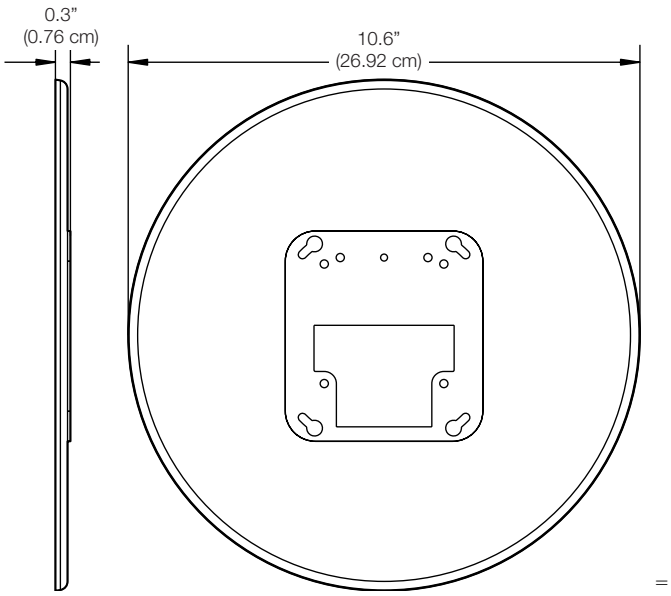


Dimensions

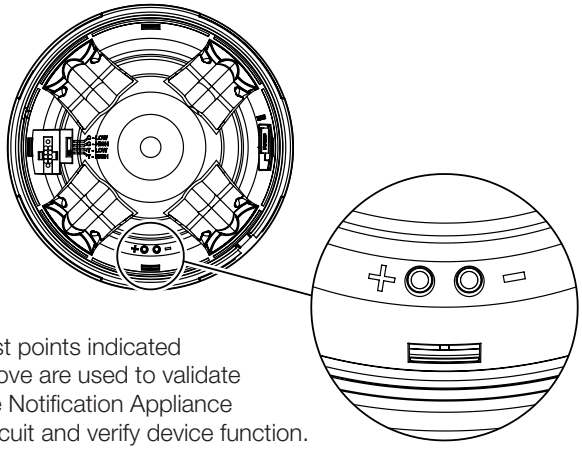
GC Notification Appliances



GCT Trim Plate (optional)



Diagnostics



Test points indicated above are used to validate the Notification Appliance Circuit and verify device function.

Field Configuration

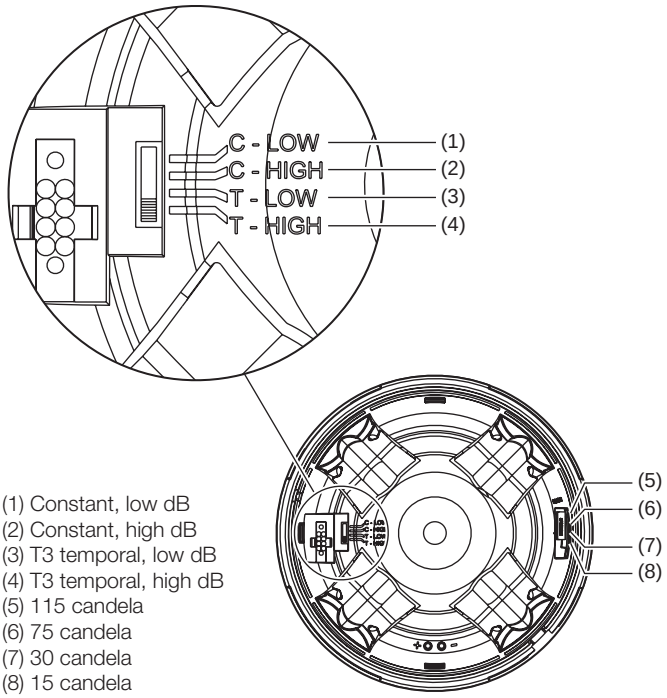
Temporal horn and horn-strobe models are factory set to sound in a three-pulse temporal pattern. By sliding the tone selector switch, horn only models may be configured for constant horn output that can be coded at precise intervals by EDWARDS control panels and control modules.

Note: Temporal 3 coding is the required output for fire notification devices per NFPA 72. Any device coding other than temporal 3 is at the discretion and approval of the local authority having jurisdiction (AHJ).

Horns and horn-strobes are factory set for high dB output. Low dB output may be selected by sliding the tone selector switch. This reduces the output by about 6 dBA.

Genesis LED clear strobes and horn-strobes may be set for 15, 30, 75, or 115 candela output. The output setting is changed by simply removing the cover and sliding the candela switch to the desired setting. The device does not have to be removed from the wall to change the output setting. The setting remains visible through a small window on the device after the cover is closed.

Light and Sound Output Settings



(1) Constant, low dB
(2) Constant, high dB
(3) T3 temporal, low dB
(4) T3 temporal, high dB
(5) 115 candela
(6) 75 candela
(7) 30 candela
(8) 15 candela

Operating current

Horns

Sound setting	16 to 33 VDC	16 to 33 VFWR
C-Low, T-Low	20 mA	25 mA
C-High, T-High	30 mA	40 mA

Strobes

Strobe setting	16 to 33 VDC	16 to 33 VFWR
15, 30, 75, 115	35 mA	45 mA

Horn-Strobes

Strobe setting	Sound setting	16 to 33 VDC	16 to 33 VFWR
15, 30, 75, 115	C-Low, T-Low	50 mA	60 mA
	C-High, T-High	60 mA	75 mA

Sound Output

Horn & Horn-Strobe

Sound setting	Reverberant (UL464)	Anechoic (CAN/ULC - S525)
C-Low, T-Low	80 dBA	86 dBA
C-High, T-High	86 dBA	92 dBA

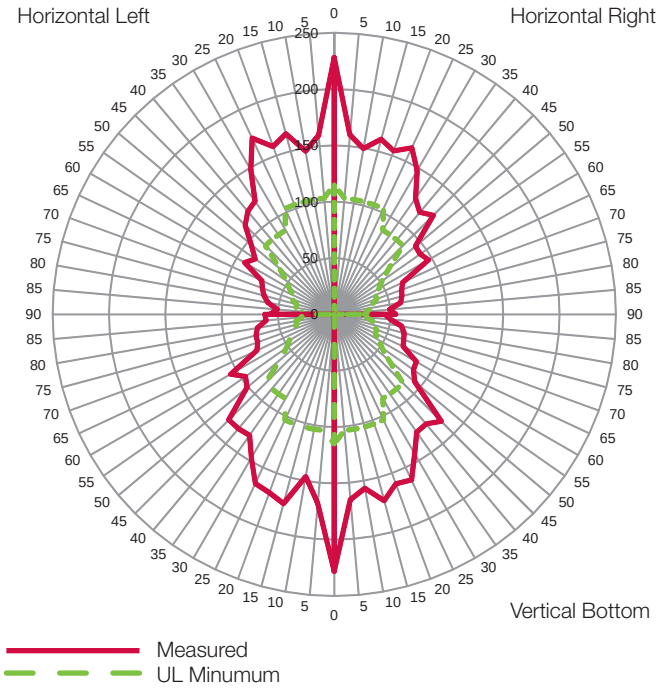
Sound pattern – Horn Models (ULC)

Axis	Angle (°)	Output (dBA)
Horizontal	115 and 55	93.3
Vertical	125 and 50	91.7

Sound pattern – Horn-Strobe Models (ULC)

Axis	Angle (°)	Output (dBA)
Horizontal	145 and 35	93.0
	155 and 35	90.8
Vertical	135 and 35	92.0
	155 and 25	85.4

Light Distribution



Specifications

Operating voltage	16 to 33 VDC, 16 to 33 VFWR
Horn signal type	Constant or TC3 temporal
Light output	15, 30, 75, or 115 candela
Strobe flash rate	1 fps (flash per second) approx.
Synchronization	20 Ω max. between any two devices. To determine allowed wire resistance, refer to these specifications, and the specifications for the synchronized signal source.
Synchronization Sources	Edwards CC Series Signal Modules, Booster and Auxiliary Power Supplies, Intelligent and Conventional Control Panels
Wire size	12 to 18 AWG (0.75 to 2.50 mm^2)
Mounting	Wall or Ceiling mount
Dimensions (Ø × D)	6.8 × 1.82 in. (17.27 × 4.62 cm)
Strobe-to-box center offset	-1.70 inches (-4.32 cm)
Compatible electrical boxes [1]	1-gang, 2-gang, 4-inch octagon, 4-inch square
Trim plates	GCTR, GCTW 10.6 × 0.3 in. (26.92 × 0.76 cm)
Operating environment	
Temperature	32 to 122°F (0 to 50°C)
Relative humidity	0 to 93% noncondensing
Storage Temperature	-40 to 158 F (-40 to 70 C)

[1] Electrical boxes must be at least 1-1/2 in. (3.81 cm) deep.

Ordering Information

Notification Appliances		Color	Marking
 Horns	GCARF	Red	FIRE
	GCARF-FR	Red	FEU
	GCARF-SP	Red	FUEGO
	GCARN	Red	None
	GCAWF	White	FIRE
	GCAWF-FR	White	FEU
	GCAWF-SP	White	FUEGO
	GCAWN	White	None
 Strobes	GCVRF	Red	FIRE
	GCVRF-FR	Red	FEU
	GCVRF-SP	Red	FUEGO
	GCVRN	Red	None
	GCVWF	White	FIRE
	GCVWF-FR	White	FEU
	GCVWF-SP	White	FUEGO
	GCVWN	White	None
 Horn-strobes	GCAVRF	Red	FIRE
	GCAVRF-FR	Red	FEU
	GCAVRF-SP	Red	FUEGO
	GCAVRN	Red	None
	GCAVWF	White	FIRE
	GCAVWF-FR	White	FEU
	GCAVWF-SP	White	FUEGO
	GCAVWN	White	None

Replacement Appliance Covers		Color	Marking
 Horn Covers	GCARA-CVR	Red	ALERT
	GCARF-CVR	Red	FIRE
	GCARF-FR-CVR	Red	FEU
	GCARF-SP-CVR	Red	FUEGO
	GCARN-CVR	Red	None
	GCAWA-CVR	White	ALERT
	GCAWF-CVR	White	FIRE
	GCAWF-FR-CVR	White	FEU
	GCAWF-SP-CVR	White	FUEGO
	GCAWN-CVR	White	None
 Strobe Covers	GCVRA-CVR	Red	ALERT
	GCVRF-CVR	Red	FIRE
	GCVRF-FR-CVR	Red	FEU
	GCVRF-SP-CVR	Red	FUEGO
	GCVRN-CVR	Red	None
	GCVWA-CVR	White	ALERT
	GCVWF-CVR	White	FIRE
	GCVWF-FR-CVR	White	FEU
	GCVWF-SP-CVR	White	FUEGO
	GCVWN-CVR	White	None
 Horn-strobe Covers	GCAVRA-CVR	Red	ALERT
	GCAVRF-CVR	Red	FIRE
	GCAVRF-FR-CVR	Red	FEU
	GCAVRF-SP-CVR	Red	FUEGO
	GCAVRN-CVR	Red	None
	GCAVWA-CVR	White	ALERT
	GCAVWF-CVR	White	FIRE
	GCAVWF-FR-CVR	White	FEU
	GCAVWF-SP-CVR	White	FUEGO
	GCAVWN-CVR	White	None

Accessories



GP10

Or



GRSW-10

Room Side Wiring Plate (required, ordered separately)



GCTR — Trim plate, GC Series, red



GCTW — Trim plate, GC Series, white

27193-21 — Two-gang surface mount box, red

27193-26 — Two-gang surface mount box, white

Model Number Syntax, Appliances

Genesis Series
GC = Ceiling mount appliances

Housing Color
R = Red
W = White

GCAVRF

Housing Marking
N = None
F-FR = FEU
F-SP = FUEGO
F = FIRE
A = ALERT*

Functions
A = Horn only
V = Strobe only
AV = Horn-Strobe

* ALERT Marking available on white strobe model only. See replacement covers for more options.

Model Number Syntax, Replacement Covers

Genesis Series
GC = Ceiling mount appliances

Housing Color
R = Red
W = White

GCAVRF-CVR

Cover Designation

Cover Marking
N = None
F-FR = FEU
F-SP = FUEGO
F = FIRE
A = ALERT

Functions
A = Horn only
V = Strobe only
AV = Horn-Strobe

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

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Website: edwardsfiresafety.com

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Bradenton, FL 34202

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DTK-HW Series

Parallel Connected Surge Protective Device



DITEK's DTK-HW Series of surge protective devices are designed and manufactured to meet the standards of the life safety industry. These compact, parallel-mount SPD's are available for 120V, 240V and 120/240V systems; and are widely used to protect fire alarm panels and other dedicated branch circuit loads. Their small footprint enables installation in a variety of locations.

Product Features

- Approved for 20A circuit breakers
- NEMA 4X weatherproof enclosure allows for use in harsh environments
- Diagnostic LED provides positive indication of system power and SPD function
- Complies with ANSI/IEEE C62.41 and C62.45 Category B standards

Applications

- Fire Alarm Control Panels
- Residential Electrical Panels
- Equipment Panels
- Pumps, Motors, Lift Pump Stations

Accessories

- DIN Rail Mounting Kit, p/n DTK-DRK

Technical Specifications

Part Number:	DTK-120HW	DTK-240HW	DTK-120/240HW
Voltage Configuration:	Single Φ (2W +G) 120VAC	Single Φ (2W +G) 240VAC	Split Φ (3W +G) 120/240VAC
MCOV:	150V/300V	320V/640V	150V/300V
Voltage Protection Rating:	700V L-G, L-N 1500V N-G	1200V L-G, L-N 2000V N-G	700V L-G, L-N 1500V L-L, N-G
Surge Current Rating:	50,000A	50,000A	100,000A
SCCR:	100,000A		
Nominal Discharge Current Rating (I_n):	10kA		

Mechanical Specifications

Connection Method:	¾" NPT Male, 18-inch 12 AWG Leads
Housing:	NEMA 4X Polycarbonate
Operating Temperature:	-31°F - 176°F (-35°C - 80°C)
Maximum Humidity:	95% non-condensing
Dimensions:	3.5" L x 1.89" W x 3.4" H (88.9 mm x 48.3 mm x 86.4 mm)
Weight:	0.55 lb (0.25 kg)

Quality Standards & Approvals

Certifications:	UL1449 4th Edition, CSA C22.2 No. 269.1-17
SPD Type:	Type 1
Warranty:	10 Year Limited Warranty

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