Telephone: 989-790-9120
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Wolgast CORPORATION

Addendum #2

Attn:	Estimator	Date:	January 16, 2026
From:	Lisa Donahue, Project Administrator	Pages:	137 (including cover page)
Re:	2023 Bond Phase 4 Project John Glenn HS - Renovations	Project:	Bangor Township School District
CC:		Proj. #:	A23906-

Architects write up	2 Pages
Revised spec 087100 Door Hardware	36 Pages
Revised spec 101100 Visual Display Units	4 Pages
Revised spec 230923 Building Automation Systems (BAS) for HVAC	52 Pages
RFI responses	23 Pages
Pre-Bid Agenda	2 Pages
Pre-Bid Sign In Sheets	3 Pages
Revised Drawings	14 Pages

Electronic bids can only be submitted using Building Connected see link
https://app.buildingconnected.com/login?retUrl=%2F

If you would like to listen while bids are being opened, use Teams.
Meeting ID: 240 206 452 617 14 Passcode: 7sM9Yq99

Paper bids go to school – see below information.
NEW Bid Date is scheduled for:
Thursday, January 22, 2026 at 3PM
Bangor Township School District
Administration Office
Matthew Schmidt, Superintendent
3359 E Midland Road
Bay City, MI 48706

IDI ARCHITECTURE ENGINEERING CONSULTING

ADDENDUM

1021 West Baraga Avenue,
Marquette, Michigan 49855
Phone (906) 228-4480

8571 W. Grand River Ave., Suite 600
Brighton, Michigan 48816
Phone: (810) 229-2701

Addendum No:	#2	Project Number:	22-011
Project:	Bangor Township School BP4 High School Renovations	Date:	01-15-2026
Issued To:	Wolgast		

The contractor shall acknowledge receipt of all addenda by listing the number where indicated on the bid form.

Drawings, specifications, and / or proposals are herein amended, expanded, and / or modified, and become a part of the Contract Documents with the same effect as if incorporated in the original documents. Any contrary provisions contained, or referred to, in Drawings and / or Specifications, shall remain applicable unless overridden by this Addendum. Revised provisions herein shall include all labor, materials, methods, modifications, etc. required for the completion of the Work.

Clarification

1. Original High School Building Reference Plans will be made available for review if this is of assistance to roof replacement bidders for information on deck types, etc.

Contract Document Modifications

Item 1: Door Hardware

New/Revised Sheets: NA
New Specifications: 087100 – Door Hardware

Item 2: Revised lighting in Area B.

Revised Sheets: E2.0, E4.2
New/Revised Specifications: NA

Item 3: Added temperature controls contractor information.

Revised Sheets: M5.0
Revised Specifications: 230923 – Building Automation Systems for HVAC

Item 4: Added special steel inspection chart as requested by State of Michigan Plan Review.

New Sheet: S0.0
New/Revised Specifications: NA

Item 5: Added/revised controls information to “Packaged Commercial Rooftop Unit Schedule” and “Packaged, Indirect-Fired, Outdoor, Heating-Only Makeup Air Unit Schedule”.

Revised Sheets: M4.0
New/Revised Specifications: NA

Item 6: Added Armstrong Ceiling Preliminary Layout Drawing for additional information on Area B Office Ceiling

New Sheets: Armstrong Drawing Package Dated 12/19/25 – 9 Pages Total (Attached)
New/Revised Specifications: NA

Item 7: Added Specification for Markerboards / Visual Display Items

New/Revised Sheets: NA
New Specification: 101100 Visual Display Units

Attachments: Revised sheets and/or specifications as outlined above.

END OF ADDENDUM

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule

2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:

a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
c. Indicate complete designations of each item required for each opening, include:
    1) Door Index: door number, heading number, and Architect's hardware set number.
    2) Quantity, type, style, function, size, and finish of each hardware item.
    3) Name and manufacturer of each item.
    4) Fastenings and other pertinent information.
    5) Location of each hardware set cross-referenced to indications on Drawings.
    6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    7) Mounting locations for hardware.
    8) Door and frame sizes and materials.
    9) Degree of door swing and handing.
    10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Final approved hardware schedule edited to reflect conditions as installed.
    d. Final keying schedule

e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105

b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) 3 years
        2) Exit Devices
            a) 3 years
        3) Closers
            a) 30 years
        4) Automatic Operators
            a) 2 years
    b. Electrical Warranty
        1) Locks
            a) 1 year
        2) Exit Devices
            a) 1 year

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.

3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. McKinney TB series
   b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Select
   b. Best

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:
   a. Securitron CEPT-10
   b. Security Door Controls PTM

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Rockwood

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series

2. Acceptable Manufacturers and Products:
   a. Sargent 8200 series
   b. Best 45H series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:
   a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
   b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.

c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
e. Connections – provide quick-connect Molex system standard.

8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
   a. Lever Design: 06A

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
   a. Detex Advantex series
   b. Precision APEX 2000 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 6000 Series

2. Acceptable Manufacturers and Products:
   a. Folger Adam 300 Series
   b. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.11 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
   a. Securitron BPS series
   b. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.
   d. Low voltage DC, regulated and filtered.
   e. Polarized connector for distribution boards.
   f. Fused primary input.
   g. AC input and DC output monitoring circuit w/LED indicators.
   h. Cover mounted AC Input indication.
   i. Tested and certified to meet UL294.
   j. NEMA 1 enclosure.
   k. Hinged cover w/lock down screws.
   l. High voltage protective cover.

2.12 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Match Owner's existing system

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.13 KEYING

A. Scheduled System:

1. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
   d. Identification:
      1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
      2) Identification stamping provisions must be approved by the Architect and Owner.
      3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.

4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.
1) Permanent Control Keys: 3.
2) Master Keys: 6.
3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
4) Key Blanks: Quantity as determined in the keying meeting.

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:
   a. Corbin-Russwin DC8000 series
   b. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.15 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. LCN 4600 series

2. Acceptable Manufacturers and Products:
   a. Norton 6000 series
   b. Besam Power Swing

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Provide automatic operator units complying with 2022 California Building Code Section 11B-404.2.9, Exception 2.
3. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
4. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
5. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
6. Provide drop plates, brackets, and adapters for arms as required for details.
7. Provide actuator switches and receivers for operation as specified.
8. Provide weather-resistant actuators at exterior applications.
9. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
10. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
11. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.19 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.20 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Legacy

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.21 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Rockwood
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.22 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Schlage

2. Acceptable Manufacturers:
   a. Nascom
   b. Security Door Controls

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.23 RELEASE SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Locknetics

2. Acceptable Manufacturers and Products:
   a. Securitron
   b. Security Door Controls

B. Requirements:

1. Provide switches for door release as specified in hardware groups. Locate as directed by architect.

2.24 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

B. FINISH: BHMA 643E/716 (US11); EXCEPT:

1. Door Closers: Powder Coat to Match.
2. Weatherstripping: Dark Bronze Anodized Aluminum.
3. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

C. FINISH: BHMA 622/631 (US19); EXCEPT:

1. Door Closers: Powder Coat to Match
2. Weatherstripping: Black
3. Thresholds: Mill Finish Black

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.

4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

HARDWARE GROUP NO. 01

For use on Door #(s):

A007 C009 F016 G013 H001.0 J002 K005.0

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	112XY			313AN	IVE
1	EA	CONT. HINGE	112XY EPT			313AN	IVE
1	EA	POWER TRANSFER	EPT10		✓	695	VON
1	EA	PANIC HARDWARE	LD-98-EO			643E	VON
1	EA	ELEC PANIC HARDWARE	QEL-98-NL-OP		✓	643E	VON
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
2	EA	FLUSH PULL	(BY DOOR/FRAME MFR.)				B/O
2	EA	OH STOP	100S			643E/716	GLY
2	EA	SURFACE CLOSER	4021			695	LCN
2	EA	TJ MOUNTING PLATE	4020-18G (AS REQ'D)			695	LCN
1	EA	MULLION SEAL	8780NBK PSA			BK	ZER
1	EA	THRESHOLD	655D-223			D	ZER
1	EA	ACCESS CONTROL	(CARD READER BY DIV 28)		✓		
2	EA	DOOR CONTACT	679-05HM		✓	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		✓	LGR	SCE

KEYED REMOVABLE MULLION BY DOOR/FRAME MANUFACTURER

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY RETRACTS PANIC DEVICE LATCH ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

HARDWARE GROUP NO. 02

For use on Door #(s):

B031.1	C017	C018	D003	E014	E015
E017	H001.1	J017	K005.1	K005.2	K005.3
K005.4	K005.5				

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		313AN	IVE
2	EA	PANIC HARDWARE	SD-98-EO		643E	VON
3	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
2	EA	FLUSH PULL	(BY DOOR/FRAME MFR.)			B/O
2	EA	OH STOP	100S		643E/716	GLY
2	EA	SURFACE CLOSER	4021		695	LCN
1	EA	TJ MOUNTING PLATE	4020-18G (AS REQ'D)		695	LCN
1	EA	THRESHOLD	655D-223		D	ZER
2	EA	DOOR CONTACT	679-05HM	✓	BLK	SCE

KEYED REMOVABLE MULLION BY DOOR/FRAME MANUFACTURER

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 03

For use on Door #(s):

K061

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		313AN	IVE
2	EA	PANIC HARDWARE	LD-98-EO		643E	VON
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
2	EA	OH STOP	100S		643E/716	GLY
2	EA	SURFACE CLOSER	4021		695	LCN
1	EA	TJ MOUNTING PLATE	4020-18G (AS REQ'D)		695	LCN
1	EA	THRESHOLD	655D-223		D	ZER
2	EA	DOOR CONTACT	679-05HM	✓	BLK	SCE

KEYED REMOVABLE MULLION BY DOOR/FRAME MANUFACTURER

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 04

For use on Door #(s):
B031.0

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	112XY			313AN	IVE
1	EA	CONT. HINGE	112XY EPT			313AN	IVE
1	EA	POWER TRANSFER	EPT10		✓	695	VON
1	EA	PANIC HARDWARE	SD-98-EO			643E	VON
1	EA	ELEC PANIC HARDWARE	SD-LX-QEL-98-NL-OP		✓	643E	VON
3	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
2	EA	FLUSH PULL	(BY DOOR/FRAME MFR.)				B/O
2	EA	OH STOP	100S			643E/716	GLY
1	EA	SURFACE CLOSER	4021			695	LCN
1	EA	SURF. AUTO OPERATOR	4640		✓	695	LCN
1	EA	TJ MOUNTING PLATE	4020-18G (AS REQ'D)			695	LCN
1	EA	WEATHER RING	8310-802		✓	PLA	LCN
2	EA	ACTUATOR, TOUCH	8310-852T		✓	630	LCN
2	EA	MOUNT BOX	8310-869F				LCN
1	EA	THRESHOLD	655D-223			D	ZER
1	EA	ACCESS CONTROL	(CARD READER BY DIV 28)		✓		
2	EA	DOOR CONTACT	679-05HM		✓	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-4RL		✓	LGR	SCE

KEYED REMOVABLE MULLION BY DOOR/FRAME MANUFACTURER

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

DOOR NORMALLY CLOSED AND LOCKED. EXTERIOR ACTUATOR DISABLED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY RETRACTS PANIC DEVICE LATCH AND ENABLES EXTERIOR ACTUATOR. PRESSING EXTERIOR ACTUATOR WHEN ENABLED SIGNALS AUTOMATIC OPERATOR TO OPEN DOOR. INTERIOR ACTUATOR ENABLED AT ALL TIMES. PRESSING INTERIOR ACTUATOR RETRACTS PANIC DEVICE LATCH AND SIGNALS AUTOMATIC OPERATOR TO OPEN DOOR. FREE EGRESS AT ALL TIMES.

HARDWARE GROUP NO. 05

For use on Door #(s):

C010 F001 G002 G003 J015 J018
K050

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		313AN	IVE
1	EA	PANIC HARDWARE	LD-98-EO		643E	VON
1	EA	SURFACE CLOSER	4111 SCUSH		695	LCN
1	EA	THRESHOLD	655D-223		D	ZER
1	EA	DOOR CONTACT	679-05HM	✓	BLK	SCE

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 06

For use on Door #(s):

J014

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		313AN	IVE
1	EA	PANIC HARDWARE	SD-98-EO		643E	VON
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	FLUSH PULL	(BY DOOR/FRAME MFR.)			B/O
1	EA	SURFACE CLOSER	4111 SCUSH		695	LCN
1	EA	THRESHOLD	655D-223		D	ZER

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 07

For use on Door #(s):
J011

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		313AN	IVE
1	EA	PANIC HARDWARE	SD-98-NL-OP		643E	VON
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	FLUSH PULL	(BY DOOR/FRAME MFR.)			B/O
1	EA	SURFACE CLOSER	4111 SCUSH		695	LCN
1	EA	THRESHOLD	655D-223		D	ZER

PERIMETER SEALS & SWEEP BY DOOR/FRAME MANUFACTURER

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY RETRACTS PANIC DEVICE LATCH ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

HARDWARE GROUP NO. 08

For use on Door #(s):
F015

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-2SI-06		710	VON
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	RIM CYL THUMBTURN	XB11-979		643e	SCH
1	EA	SURFACE CLOSER	4111 EDA		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 09

For use on Door #(s):
B120.0 B120.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-2SI-06		710	VON
1	EA	RIM CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	RIM CYL THUMBTURN	XB11-979		643e	SCH
1	EA	SURFACE CLOSER	4111 SCUSH		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

PRIOR TO ORDERING/INSTALLING NEW MATERIAL, VERIFY/COORDINATE PREPS ON EXISTING DOORS AND FRAMES TO ENSURE COMPATIBILITY OF NEW HARDWARE. PROVIDE FIELD MODIFICATIONS AND/OR NECESSARY FILLERS (PAINT TO MATCH WHERE EXISTING IS PREVIOUSLY PAINTED), REINFORCEMENTS AND FASTENERS, COMPATIBLE WITH EXISTING MATERIALS REQUIRED FOR MOUNTING NEW SPECIFIED HARDWARE AND TO COVER EXISTING DOOR AND FRAME PREPARATIONS.

HARDWARE GROUP NO. 10

For use on Door #(s):
B114

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A 09-544		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4011		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP/HOLDER	WS45/WS45X		B643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 11

For use on Door #(s):
B111 B112 B113

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A 09-544		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	429D		D	ZER
1	EA	AUTO DOOR BOTTOM	364AA-Z49		AA	ZER
1	EA	THRESHOLD	164D-223		D	ZER

HARDWARE GROUP NO. 12

For use on Door #(s):
B105.0 B106.0 B107.0

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A 09-544		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 13

For use on Door #(s):
C014

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A 09-544		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4011		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

PRIOR TO ORDERING/INSTALLING NEW MATERIAL, VERIFY/COORDINATE PREPS ON EXISTING DOORS AND FRAMES TO ENSURE COMPATIBILITY OF NEW HARDWARE. PROVIDE FIELD MODIFICATIONS AND/OR NECESSARY FILLERS (PAINT TO MATCH WHERE EXISTING IS PREVIOUSLY PAINTED), REINFORCEMENTS AND FASTENERS, COMPATIBLE WITH EXISTING MATERIALS REQUIRED FOR MOUNTING NEW SPECIFIED HARDWARE AND TO COVER EXISTING DOOR AND FRAME PREPARATIONS.

HARDWARE GROUP NO. 14

For use on Door #(s):
B115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A 09-544		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4111 EDA		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 15

For use on Door #(s):
B110.0

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK W/ INSIDE INDICATOR	L9050L 06A 09-544 IS-LOC		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4111 SCUSH		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 16

For use on Door #(s):
B110.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE/ENTRY LOCK W/ INSIDE INDICATOR	L9050L 06A 09-544 IS-LOC		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4111 EDA		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 17

For use on Door #(s):
B102

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	OFFICE W/SIM RETRACT W/ OUTSIDE INDICATOR	L9056L 06A 09-544 OS-OCC		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4011		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 18

For use on Door #(s):
B104.2 B109

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	STOREROOM LOCK	L9080L 06A		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4111 EDA		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 19

For use on Door #(s):
B104.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	STOREROOM LOCK	L9080L 06A		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4011		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS443/447		643E/716	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. 20

For use on Door #(s):
A004

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)		F643E/716	IVE
1	EA	STOREROOM LOCK	L9080L 06A		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
1	EA	SURFACE CLOSER	4111 SCUSH		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

PRIOR TO ORDERING/INSTALLING NEW MATERIAL, VERIFY/COORDINATE PREPS ON EXISTING DOORS AND FRAMES TO ENSURE COMPATIBILITY OF NEW HARDWARE. PROVIDE FIELD MODIFICATIONS AND/OR NECESSARY FILLERS (PAINT TO MATCH WHERE EXISTING IS PREVIOUSLY PAINTED), REINFORCEMENTS AND FASTENERS, COMPATIBLE WITH EXISTING MATERIALS REQUIRED FOR MOUNTING NEW SPECIFIED HARDWARE AND TO COVER EXISTING DOOR AND FRAME PREPARATIONS.

HARDWARE GROUP NO. 21

For use on Door #(s):
K052

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		313AN	IVE
1	EA	AUTO FLUSH BOLT	FB31P/FB41P (AS REQ'D)		613	IVE
1	EA	DUST PROOF STRIKE	DP2		613	IVE
1	EA	STOREROOM LOCK	L9080L LLL 06A L283-150 - LESS OUTSIDE LEVER		643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		643e	
2	EA	FLUSH PULL	(BY DOOR/FRAME MFR.)			B/O
1	EA	COORDINATOR	COR X FL (MB AS REQ'D)		711	IVE
2	EA	SURFACE CLOSER	4111 SCUSH SRI		695	LCN
1	EA	OVERLAPPING ASTRAGAL	(BY DOOR/FRAME MFR.)			B/O

PERIMETER SEALS BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 22

For use on Door #(s):
B100.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)			F643E/716	IVE
1	EA	STOREROOM LOCK	L9080L 06A			643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
1	EA	ELECTRIC STRIKE	6211 FSE		✓	613	VON
1	EA	OH STOP	100S			643E/716	GLY
1	EA	SURF. AUTO OPERATOR	4640		✓	695	LCN
2	EA	ACTUATOR, TOUCH	8310-852T		✓	630	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			613	IVE
1	EA	GASKETING	488SBK PSA			BK	ZER
1	EA	ACCESS CONTROL	(CARD READER BY DIV 28)		✓		
1	EA	DESK MOUNT BUTTON	660-PB (AT RECEPTION DESK)		✓	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		✓	LGR	SCE

DOOR NORMALLY CLOSED AND LOCKED. EXTERIOR ACTUATOR DISABLED. PRESENTING VALID CREDENTIAL TO READER MOMENTARILY RETRACTS LATCH AND ENABLES EXTERIOR ACTUATOR. PRESSING EXTERIOR ACTUATOR WHEN ENABLED SIGNALS AUTOMATIC OPERATOR TO OPEN DOOR. INTERIOR ACTUATOR ENABLED AT ALL TIMES. PRESSING INTERIOR ACTUATOR RETRACTS LATCH AND SIGNALS AUTOMATIC OPERATOR TO OPEN DOOR. FREE EGRESS AT ALL TIMES.

HARDWARE GROUP NO. 23

For use on Door #(s):
B100.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)			F643E/716	IVE
1	EA	INSTITUTION LOCK	L9082L 06A			643e	SCH
2	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
1	EA	ELECTRIC STRIKE	6211 FSE		✓	613	VON
1	EA	SURFACE CLOSER	4111 EDA			695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			613	IVE
1	EA	WALL STOP	WS443/447			643E/716	IVE
1	EA	GASKETING	488SBK PSA			BK	ZER
2	EA	ACCESS CONTROL	(CARD READER BY DIV 28)		✓		
1	EA	DESK MOUNT BUTTON	660-PB (AT RECEPTION DESK)		✓	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		✓	LGR	SCE
1	EA	WAVE TO OPEN SWITCH	WS-200-MB		✓	630	LOC

OPERATIONAL DESCRIPTION:
(SCHOOL HOURS): DOORS NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM FROM BOTH SIDES. PRESENTING A VALID CREDENTIAL TO THE READER, REMOTE RELEASE BUTTON OR WAVE ACTUATOR ON CORRIDOR SIDE WILL MOMENTARILY DROP POWER TO ELECTRIC STRIKE ALLOWING ACCESS.

(AFTER HOURS): DOORS NORMALLY CLOSED AND LOCKED VIA ACCESS CONTROL SYSTEM FROM BOTH SIDES. REMOTE RELEASE BUTTON AND WAVE ACTUATOR DISABLED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT, AND ALL RELATED TRADES.

HARDWARE GROUP NO. 24

For use on Door #(s):
B115A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP)			F643E/716	IVE
1	EA	POWER TRANSFER	EPT10		✓	695	VON
1	EA	EU MORTISE LOCK	L9092LEU 06A		✓	643e	SCH
1	EA	MORTISE CYLINDER/PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			643e	
1	EA	SURFACE CLOSER	4111 EDA			695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			613	IVE
1	EA	WALL STOP	WS443/447			643E/716	IVE
1	EA	GASKETING	488SBK PSA			BK	ZER
1	EA	ACCESS CONTROL	(CARD READER BY DIV 28)		✓		
1	EA	POWER SUPPLY	PS902 900-2RS		✓	LGR	SCE

END OF SECTION

SECTION 101100
VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Section Includes:

1. Porcelain Enamel Steel Markerboards
2. Tack boards and strips

1.2 REFERENCED STANDARDS

A. American Society for Testing Materials

1. ASTM B221Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.
2. ANSI Z97.1 Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test
3. ASTM E84 Standard Test Method for Surface Burning Characteristics for Building Materials
4. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wires, Profiles and Tubes

B. Porcelain Enamel Institute

1. PEI-1002 Manual and Performance Specifications for Porcelain Enamel Writing Surfaces

1.3 SUBMITTALS

A. Shop Drawings: Provide shop drawings for each visual display board required.

B. Product Data: Provide technical data for materials specified. Include Material Safety Data Sheets, when applicable.

C. Samples and color charts: Provide Manufacturer's color charts and composition samples of face, core, backing and trim to illustrate finish, color and texture, where required.

D. Manufacturer's Instructions: Provide Manufacturer's installation and cleaning instructions.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall be a firm engaged in the manufacture of visual display boards in the United States.
2. Manufacturer shall have a minimum of 5 years' experience in the manufacture of visual display boards.

B. Regulatory Requirements: Conforms to applicable code for flame/smoke rating in tackboards in accordance with ASTM E84.

C. Operation and Maintenance: Include data on regular cleaning, stain removal, and precautions.

1.5 PROJECT CONDITIONS

A. Field measure prior to preparation of shop drawings and fabrication to ensure proper fit.

B. Comply with manufacturer's recommendations for acclimatizing area for interior moisture and temperature to approximate normal occupied conditions.

1.6 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of visual display boards with spaces sufficiently complete so that visual display boards can be installed upon delivery.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store materials protected from exposure to harmful weather conditions and at temperatures and humidity conditions recommended by manufacturer.

1.7 WARRANTY

A. Submit a "Life of the Building" warranty, stating that under normal usage and maintenance, and when installed in accordance with manufacturer's instructions and recommendations, porcelain enamel steel markerboard writing surfaces are guaranteed for the Life of the Building. Guarantee covers replacement of defective boards but does not include cost of removal or reinstallation.

B. Submit a standard warranty, stating that when installed in accordance with manufacturer's instructions and recommendations, tackboards are guaranteed for one year against defects in materials and workmanship. Guarantee does not cover normal wear and tear, improper handling, any misuse, or any defects caused by vandalism or subsequent abuse. Guarantee covers replacement of defective material but does not include cost of removal or reinstallation.

C. Submit a standard warranty, stating that under normal usage and maintenance, and when installed in accordance with manufacturer's instructions and recommendations, Manufacturer glass marker wall writing surfaces are guaranteed for 10 years. Guarantee covers replacement of defective boards but does not include cost of removal or reinstallation.

D. Writing Surface Warranty Period: 10 years commencing on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Claridge Products and Equipment, Inc.
B. Koraseal
C. Magnatag Visible Systems
D. PolyVision Corporation

2.2 MATERIALS

A. Writing Surface Face Sheet – Manufactured in accordance with Porcelain Enamel Institute's specification.

1. Shall be enameling grade cold rolled steel manufactured from a minimum of 30 percent post-consumer and post-industrial waste.

2. Enameling grade steel shall be coated with LCS³ Porcelain Enamel by Claridge Products and Equipment.

a. 3-Coat process shall include:
1) Bottom Ground Coat – 1.5 to 2.2 mils
2) Top Ground Coat – 2.0 to 2.8 mils
3) Top Cover (Color) Coat – 3.0 to 4.0 mils

3. Firing Temperature: Enamel shall be fired at lowest possible temperatures to reduce steel and porcelain stresses and achieve superior enamel and hardness.

4. Color: As selected by architect from manufacturer's standards.

B. Writing Surface Core 1. 7/16" Medium Density Fiberboard (MDF) composed of approximately 90% postindustrial waste.

C. Writing Surface Backing 1. Moisture Barrier Back 2. Foil Back 3. Aluminum Sheet Back 4. Steel Back

D. Factory Framed Markerboards and Chalkboards

1. Face Sheet: (Specify LCS³ porcelain enamel steel Markerboard; or porcelain enamel steel Chalkboard)
2. Core Material: (Specify 7/16" MDF)
3. Backing: (Specify Moisture Barrier Back; Foil Back; Aluminum Sheet Back; or Steel Back)
4. Series: (Specify Series 1, 3, 4, 5, 8, or 185)
5. Markerboard with Tackboard Top Trim, refer to drawings.
6. Panel Size: refer to drawings.
7. Color: as selected from manufacturer's standard colors.

2.3 ALUMINUM TRIM

A. Trim shall be 6063 alloy grade aluminum with T5 tempering in accordance with ASTM B221, and shall have 201-R1 satin anodize finish. (Color Anodize and Powder Coat finishes optional)

1. Factory Built Trim Series: (Series 1)
2. Marker Tray/Chalktrough

a. Continuous, hollow aluminum tray with cast aluminum end closures at bottom of each markerboard or chalkboard
b. Continuous 2" map rail with cork insert and end stops at the top of each markerboard and chalkboard
c. Map Hooks: (Two map hooks furnished for map rail on factory-framed units)

2.4 PROJECT CONDITIONS

A. Verify before installation that interior moisture and temperature approximate normal occupied conditions.

B. Verify that wall surfaces are prepared and ready to receive panels.

2.5 INSTALLATION

A. Deliver factory built units completely assembled and of dimensions shown in details and in accordance with manufacturers shop drawings as approved by the architect.

B. Deliver in accordance with manufacturer's shop drawings as approved by the architect.

C. Follow manufacturer's instructions for storage and handling of units before installation.

D. Do not install on damp walls or in damp and humid weather without heat in the building.

E. Install level and plumb, keeping perimeter trim straight in accordance with manufacturer's recommendations.

2.6 ADJUST AND CLEAN

A. Verify that all accessories are installed as required for each unit.

B. At completion of work, clean surfaces and trim in accordance with manufacturer's recommendations, leaving all materials ready for use.

END OF SECTION

SECTION 230923 – BUILDING AUTOMATION SYSTEMS (BAS) FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. BAS Building Automation System (BAS) Contractor shall furnish and install all components necessary to install a new fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control for all new unit ventilators and associated relief dampers, as well as existing cabinet heaters and convectors indicated.
2. The BAS shall include all required computer software and hardware, controllers, sensors, transmission equipment, system workstations, local panels, conduit, wire, installation, engineering, database and setup, supervision, commissioning, acceptance test, training, warranty service and, at the owner's option, extended warranty service.
3. Assure that every HVAC device specified in Division 23 as well as all existing mechanical systems and components indicated on the plans is properly controlled. It is the responsibility of the Controls Contractor to furnish and install all hardware, software, relays, and programming necessary to assure interoperability between HVAC systems, equipment, or devices.
4. Provide all valves (installed by mechanical contractor), valve actuators, damper actuators, sensors, and other end devices and sensors as may be necessary to provide complete control and supervision of the functions indicated. Deliver to HVAC or appropriate installers for field installation.
5. Controls system shall be complete with Dynamic Graphics package that can be accessed from any networked workstation utilizing a standard web browser for all systems being installed under this work.
6. Integration of all facilities BAS Controls onto a single open-protocol Tridium controls platform is required unless written approval is obtained in advance of the controls work being performed.
7. Log on to access all programming functions, set-point and time scheduling functions, trend logs, and other control functions shall be internet accessible from any computer or web portal device independently of the clients own "secure internet" network. Work closely with the clients IT oversight person when preparing the controls network architecture
8. Provide open-communication protocol, graphics and all system controls components for all BAS system controls being installed throughout the district.

B. Related Requirements:

1. Section 236200 Packaged Compressor and Condenser Units;
2. Section 237313.16 Indoor, Semi-Custom Air-Handling Units;
3. Control Diagrams and Sequence of Operations shown on the Construction Drawings;
4. Division 26 – Electrical for all low voltage and line voltage wiring, raceways, conduit, boxes, and labeling.

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. BAS: Building Automation System for primarily controlling HVAC systems and components, but may incorporate control of other building functions such as lighting, security cameras and door locks, etc.

E. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

F. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

G. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

H. COV: Changes of value.

I. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

J. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

K. DOCSIS: Data-Over Cable Service Interface Specifications.

L. E/P: Voltage to pneumatic.

M. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

N. HLC: Heavy load conditions.

O. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

P. I/P: Current to pneumatic.

Q. LAN: Local area network.

R. LNS: LonWorks Network Services.

S. LON Specific Definitions:

1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
4. LonWorks: Network technology developed by Echelon.
5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.
9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark International for configuration properties.
10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").
11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.
13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.
14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.
15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.

T. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

U. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.

V. Modbus TCP/IP: An open protocol for exchange of process data.

W. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

X. MTBF: Mean time between failures.

Y. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

Z. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

AA. Peer to Peer: Networking architecture that treats all network stations as equal partners.

BB. POT: Portable operator's terminal.

CC. PUE: Performance usage effectiveness.

DD. RAM: Random access memory.

EE. RF: Radio frequency.

FF. Router: Device connecting two or more networks at network layer.

GG. Server: Computer used to maintain system configuration, historical and programming database.

HH. TCP/IP: Transport control protocol/Internet protocol.

II. UPS: Uninterruptible power supply.

JJ. USB: Universal Serial Bus.

KK. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

LL. VAV: Variable air volume.

MM. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

    a. Workstations.
    b. Servers.
    c. Gateways.
    d. Routers.
    e. Protocol analyzers.
    f. DDC controllers.
    g. Enclosures.
    h. Electrical power devices.
    i. Accessories.
    j. Instruments.
    k. Control dampers and actuators.
    l. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.

10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

C. Shop Drawings:

1. General Requirements:

    a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Each desktop workstation, server, gateway, router, BAS controller, control panel instrument connecting to BAS controller, and damper and valve connecting to BAS controller, if included in Project.
    d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
    e. Network communication cable and raceway routing.
    f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

4. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to BAS controllers.
    g. Narrative sequence of operation.
    h. Graphic sequence of operation, showing all inputs and output logical blocks.

5. Control panel drawings indicating the following:

    a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
    b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.

c. Front, rear, and side elevations and nameplate legend.
d. Unique drawing for each panel.

6. BAS system network riser diagram indicating the following:

a. Each device connected to network with unique identification for each.
b. Interconnection of each different network in DDC system.
c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

7. BAS system electrical power riser diagram indicating the following:

a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
d. Power wiring type and size, race type, and size for each.

8. Monitoring and control signal diagrams indicating the following:

a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.
c. Control signal tubing to sensors, switches and transmitters.
d. Process signal tubing to sensors, switches and transmitters..

D. System Description:

1. Full description of BAS architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition
4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

E. Delegated-Design Submittal: For BAS system products and installation indicated as being delegated.

1. Supporting documentation showing BAS system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule control dampers and actuators.
3. Schedule for control valves and actuators.
4. Schedule for flow instruments.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Product installation location shown in relationship to room, duct, pipe and equipment.
b. Structural members to which products will be attached.
c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
d. Size and location of wall access panels for products installed behind walls and requiring access.

2. Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.

PART 2 - PRODUCTS

2.1 BAS SYSTEM MANUFACTURERS

A. Smart Building Services (SBS) is the current and preferred temperature controls contractor.
B. Contact: Andrew Bosse, andrewb@sbsmi.com, 616-862-3674

2.2 BAS SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. BAS system shall consist of a high-speed peer-to-peer network of distributed BAS controllers, other network devices, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 WEB ACCESS

A. BAS system shall be Web based.

1. Web-Based Access to BAS:
a. BAS software shall be designed around open standards of Web technology. BAS server shall be accessed using a Web browser over BAS network, using Owner's LAN, and remotely over Internet through Owner's LAN. Controls contractor shall

be responsible for working with the Owners IT personnel to coordinate the Internet access.

b. Provide operators complete access to BAS system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.

c. Web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. BAS shall satisfy requirements indicated.

1. System Performance Objectives:

a. BAS shall manage HVAC systems.

b. BAS control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.

c. BAS shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.

d. BAS shall operate while unattended by an operator and through operator interaction.

e. BAS shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Network Bandwidth: Design each network of BAS to include at least 30 percent available spare bandwidth with BAS operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

D. BAS Data Storage:

1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. Local Storage:

a. Provide server with data storage indicated. Server(s) shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.

3. Cloud Storage:

a. Provide web browser interfaces to configure, upload, download, and manage data, and service plan with storage adequate to store all data for term indicated. Cloud storage shall use IT industry standard database platforms and be capable of functions described in "BAS Data Access" Paragraph.

E. BAS Data Access:

1. When logged into the system, operator shall be able to also interact with any BAS controller connected to BAS as required for functional operation of the system.
2. System(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

F. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
2. Products shall be protected with enclosures that withstand the environment in which they will be installed. Products not available with integral enclosures that comply shall be housed in protective secondary enclosures. Installed location shall dictate the NEMA 250 enclosure requirements.

G. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
   a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

H. Electric Power Quality:

1. Power-Line Surges:

   a. Protect susceptible BAS products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
   b. Do not use fuses for surge protection.

2. Power Conditioning:

   a. Protect susceptible BAS products connected to ac power circuits from irregularities and noise rejection.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

I. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated BAS products that control such systems and equipment also served from a backup power source.

J. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring

immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 SYSTEM ARCHITECTURE

A. BAS shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.

B. System architecture shall perform modifications without having to remove and replace existing network equipment.

C. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

D. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

2.6 BAS SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire BAS through any of multiple means, including, but not limited to, remote connection through web access.

B. Desktop Workstations:

1. Connect to BAS Level one LAN through a communications port directly on LAN or through a communications port on a BAS controller.
2. Able to communicate with any device located on any BAS LAN.

C. Portable Workstations:

1. Connect to BAS Level one LAN through a communications port directly on LAN or through a communications port on a BAS controller.
2. Able to communicate with any device located on any BAS LAN.
3. Connect to system through a wireless router connected to Level one LAN.
4. Connect to system through a cellular data service.
5. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
6. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
7. Have dynamic graphic displays that are identical to desktop workstations.

D. Mobile Device:

1. Connect to system through a wireless router connected to LAN and cellular data service.

E. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by BAS to notify operator of critical alarms that require immediate attention.
2. BAS shall send alarm notification to multiple recipients that are assigned for each alarm.

3. BAS shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

F. Simultaneous Operator Use: Capable of accommodating up to a minimum of five simultaneous operators that are accessing BAS through any one of operator interfaces indicated.

2.7 NETWORKS

A. Assure that the BAS being installed will operate and function on the network within the clients facility for connecting workstations, mobile devices, and network controllers.

2.8 DDC SYSTEM WIRELESS NETWORKS

A. Use an open industry standard technology to create a wireless mesh network to provide wireless connectivity for network devices at multiple system levels including communications from programmable application controllers and application-specific controllers to temperature sensors and from network controllers to programmable application controllers and application-specific controllers.

B. Installer shall design wireless networks to comply with DDC system performance requirements indicated. Wireless network devices shall co-exist on same network with hardwired devices.

C. Hardwired controllers shall be capable of retrofit to wireless devices with no special software.

D. A wireless coordinator shall provide a wireless interface between programmable application controllers, application-specific controllers, and network controllers.

E. Wireless System Components shall comply with the following:

1. Use direct sequence spread spectrum RF technology.
2. Operate on the 2.4-GHz ISM Band.
3. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
4. FCC compliant to 47 CFR 15, Subpart B, Class A.
5. Operate as a bidirectional transceiver with sensors and routers to confirm and synchronize data transmission.
6. Capable of communication with sensors and routers up to a maximum distance of 250 feet in line of sight.
7. Include visual indicators to provide diagnostic information required for operator verification of operation.

F. Wireless Coordinators:

1. Each wireless mesh network shall use wireless coordinator(s) for initiation and formation of network.

G. Wireless Routers:

1. Each wireless mesh network shall use wireless routers with any controller to provide a wireless interface to a network controller, through a wireless coordinator.
2. Include indication for use in commissioning and troubleshooting.

H. Wireless Temperature Sensors:

1. Wireless temperature sensors shall sense and transmit room temperatures, temperature set point, room occupancy notification and low battery condition to an associated router.
2. Multiple sensors shall be able to report to a router connected to a DDC controller for averaging or high and low selection.

I. One-to-One Wireless Network Receivers:

1. One-to-one wireless receivers shall receive wireless RF signals containing temperature data from multiple wireless room temperature sensors and communicate information to programmable application controllers or application-specific controllers.

J. One-to-One Wireless Network Sensors:

1. One-to-one wireless sensors shall sense and report room temperatures to one-to-one receiver.
   a. Include set point adjustment between 55 to 85 deg F.

2.9 DESKTOP WORKSTATIONS

A. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.

C. Wireless Ethernet, 802.11 a/b/g/n.

1. Optical Modem: Full duplex link for connection to optical fiber cable provided.
2. I/O Ports:

   a. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
   b. One serial port.
   c. One parallel port.
   d. Two PS/2 ports.
   e. One RJ-45.
   f. One stereo line-in and headphone/line-out on back panel.
   g. One microphone and headphone connector on front panel.
   h. One IEEE 1394 on front and back panel with PCI-e card.
   i. One ESATA port on back panel.

3. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

D. Keyboard:

1. 101 enhanced keyboard.
2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
3. Wireless operation within up to 72 inches in front of workstation.

E. Pointing Device:

1. Either a two- or three-button mouse.
2. Wireless operation within up to 72 inches in front of workstation.

F. Flat Panel Display Monitor:

1. Display:
   a. Color display with minimum 28" diagonal viewable area.
   b. Digital or analog input signal.
   c. Aspect Ratio: 16 to 9.
   d. Antiglare display.
   e. Dynamic Contrast Ratio: 50000 to 1.
   f. Energy Star compliant.
   g. Resolution: 1920 by 1080 pixels at 60 Hz

G. I/O Cabling: Include applicable cabling to connect I/O devices.

2.10 SERVERS

A. Description: x86 based permanently installed computer used for client-server computing.

B. Servers shall include the following:

1. Full-feature backup server (server and backup minimum requirement).
2. Software licenses.
3. Cable installation between server(s) and network.

C. Web Server:

1. If required to be separate, include Web server hardware and software to match, except backup server is not required.
2. Firewalls between server Web and networks.
3. Password protection for access to server from Web server.
4. Cable installation between the server(s) and building Ethernet network.

2.11 PRINTERS

A. Black and White Laser Printer:

1. 1200 by 1200 dots per inch resolution.
2. Complies with Energy Star requirements.
3. Capable of handling letter- and legal-size paper and overhead transparencies.
4. Two paper trays;

2.12 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.

2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:

    a. Operator access to BAS shall be under password control.
    b. An alphanumeric password shall be field assignable to each operator.
    c. Operators shall be able to access BAS by entry of proper password.
    d. Operator password shall be same regardless of which computer or other interface means is used.
    e. Additions or changes made to passwords shall be updated automatically.
    f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
    g. Software shall have at least five access levels.
    h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
    i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

    a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
    b. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
    c. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
    d. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.

e. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

a. Start or stop selected equipment.
b. Adjust set points.
c. Add, modify, and delete time programming.
d. Enable and disable process execution.
e. Lock and unlock alarm reporting for each point.
f. Enable and disable totalization for each point.
g. Enable and disable trending for each point.
h. Override control loop set points.
i. Enter temporary override schedules.
j. Define holiday schedules.
k. Change time and date.
l. Enter and modify analog alarm limits.
m. Enter and modify analog warning limits.
n. View limits.
o. Enable and disable demand limiting.
p. Enable and disable duty cycle.
q. Display logic programming for each control sequence.

9. Reporting:

a. Generated automatically and manually.
b. Sent to displays, printers and disk files.
c. Types of Reporting:

1) General listing of points.
2) List points currently in alarm.
3) List of off-line points.
4) List points currently in override status.
5) List of disabled points.
6) List points currently locked out.
7) List of items defined in a "Follow-Up" file.
8) List weekly schedules.
9) List holiday programming.
10) List of limits and dead-bands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.

4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
7. Graphics are to be online programmable and under password control.
8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
9. Graphics shall also contain software points.
10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by BAS with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. Points shall be dynamic with operator adjustable update rates on a per point basis.
19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

    a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.
    b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
    c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
21. Help Features:

    a. On-line context-sensitive help utility to facilitate operator training and understanding.
    b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

        1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

    c. Available for Every Menu Item:

1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

    a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves pumps, and electrical symbols.
    b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

        1) Define background screens.
        2) Define connecting lines and curves.
        3) Locate, orient and size descriptive text.
        4) Define and display colors for all elements.
        5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by BAS.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

    a. Room layouts with room identification and name.
    b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by BAS.
    c. Location and identification of each hardware point being controlled or monitored by BAS.

3. Control schematic for each of following, including a graphic system schematic representation with point identification, set point and dynamic value indication, and sequence of operation.
4. Graphic display for each piece of equipment connected to BAS through a data communications link. Include dynamic indication of all points associated with equipment.
5. BAS network riser diagram that shows schematic layout for entire system including all networks and all controllers.

E. Customizing Software:

1. Software to modify and tailor BAS to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of BAS configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:

    a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
    c. System configuration and diagnostic capability shall include communications and peripheral port assignments, BAS controller assignments to network, BAS

controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.

d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.

e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.

f. Point related change capability shall include the following:

1) System and point enable and disable.
2) Run-time enable and disable.
3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
4) Assignment of alarm and warning limits.

g. Application program change capability shall include the following:

1) Enable and disable of software programs.
2) Programming changes.
3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.

4. Software shall allow operator to add points, or groups of points, to BAS and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through BAS controllers.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to BAS.
4. Alarms display shall include the following:

a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
c. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using BAS I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on BAS controller, within storage limits of BAS controller, and then uploaded to archive on for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on server hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard BAS reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:
   a. Alarm history.
   b. System messages.
   c. System events.
   d. Trends.

I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

J. Programming Software:

1. Include programming software to execute sequences of operation indicated.
2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
3. Programming software shall be:

   a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for BAS control systems.

      1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
      2) Programming tools shall be viewable in real time to show present values and logical results of each function block.

   b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
   c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.

4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

K. Database Management Software:

1. Where a separate SQL database is used for information storage, BAS shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of BAS applications.
3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

    a. Backup.
    b. Purge.
    c. Restore.

4. Database management software shall support the following:

    a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
    b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
    c. Backup: Include means to create a database backup file and select a storage location.
    d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:

    a. Ready.
    b. Purging record from a database.
    c. Action failed.
    d. Refreshing statistics.
    e. Restoring database.
    f. Shrinking a database.
    g. Backing up a database.
    h. Resetting Internet information services.
    i. Starting network device manager.
    j. Shutting down the network device manager.
    k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.
7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.
8. Monitoring settings window shall have the following sections:
    a. Allow operator to set and review scan intervals and start times.
    b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
    c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.

d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:

a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

2.13 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, ERV's and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet BAS-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.14 BAS CONTROLLERS

A. BAS shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. BAS controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. BAS controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each BAS controller shall be capable of full and complete operation as a completely independent unit and as a part of a BAS wide distributed network.

E. Environment Requirements:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
3. Controllers located outdoors shall be rated for operation at -25 to 120 deg F.

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. BAS Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

    a. Network Controllers: 50 percent.
    b. Programmable Application Controllers: Not less than 60 percent.
    c. Application-Specific Controllers: Not less than 70 percent.

2. Memory shall support BAS controller's operating system and database and shall include the following:

    a. Monitoring and control.
    b. Energy management, operation and optimization applications.
    c. Alarm management.
    d. Historical trend data of all connected I/O points.
    e. Maintenance applications.
    f. Operator interfaces.
    g. Monitoring of manual overrides.

H. BAS Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network, Programmable Application, and Application Specific Controllers:

    a. 20 percent of each AI, AO, BI, and BO point connected to controller.
    b. Minimum Spare I/O Points per Controller:

        1) AIs: Three
        2) AOs: Three.
        3) BIs: Three.
        4) BOs: Three.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.

2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

2.15 NETWORK AND PROGRAMMABLE APPLICATION CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.

C. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.16 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.17 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. Control functions shall be executed within controllers using BAS algorithms.
3. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:

a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.
d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:

a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:

a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Electric Power Demand Limiting (when applicable):

1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.
2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:

    a. Reset air-handling unit supply temperature set points.
    b. Reset space temperature set points.
    c. De-energize equipment based on priority.

4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
6. Include means operator to make the following changes online:

a. Addition and deletion of loads controlled.
b. Changes in demand intervals.
c. Changes in demand limit for meter(s).
d. Maximum shutoff time for equipment.
e. Minimum shutoff time for equipment.
f. Select rotational or sequential shedding and restoring.
g. Shed and restore priority.

7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:

a. Total electric consumption.
b. Peak demand.
c. Date and time of peak demand.
d. Daily peak demand.

J. Maintenance Management (when applicable): System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

L. Control Loops:

1. Support any of the following control loops, as applicable to control required:

a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.

1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

N. Energy Calculations:

1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.

O. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

P. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

Q. Run-Time Totalization:

1. Include software to totalize run-times for all BI points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.18 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
3. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
4. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
5. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Include a barrier between line-voltage and low-voltage electrical and electronic products.
3. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
4. Terminate field cable and wire using heavy-duty terminal blocks.
5. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
6. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background.
7. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
8. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.

2. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
3. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.

2.19 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Pickup Time: 15 ms or less.
    d. Dropout Time: 10 ms or less.
    e. Pull-in Voltage: 85 percent of rated voltage.
    f. Dropout Voltage: 50 percent of nominal rated voltage.
    g. Power Consumption: 2 VA.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
    d. Repeatability: Within 2 percent.
    e. Recycle Time: 45 ms.
    f. Minimum Pulse Width Control: 50 ms.
    g. Power Consumption: 5 VA or less at 120-V ac.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Pickup Time: 15 ms or less.
    d. Dropout Time: 10 ms or less.
    e. Pull-in Voltage: 85 percent of rated voltage.
    f. Dropout Voltage: 50 percent of nominal rated voltage.
    g. Power Consumption: 2 VA.

7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Description:

    a. On-off control and status indication in a single device.
    b. LED status indication of activated relay and current trigger.
    c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:

    a. Ambient Temperature: Minus 30 to 140 deg F.
    b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.

3. Status Indication:

    a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
    b. Current Sensor Range: As required by application.
    c. Current Set Point: Fixed or adjustable as required by application.
    d. Current Sensor Output:

        1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
        2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
        3) Analog, zero- to 5- or 10-V dc.
        4) Analog, 4 to 20 mA, loop powered.

4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
5. Enclosure: NEMA 250, Type 1 enclosure.

2.20 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 40 VA.
3. Transformer shall have both primary and secondary fuses.

2.21 PIPING AND TUBING

A. Process Tubing:

1. Products in this paragraph are intended for signals to instruments connected to liquid and steam systems.
2. Copper Tubing:

    a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered with chemical and physical properties according to ASTM B 75.
    b. Performance, dimensions, weight and tolerance according to ASTM B 280.
    c. Diameter, as required by application, of not less than nominal 0.25 inch.

3. Copper Tubing Connectors and Fittings:

    a. Brass, compression or solder-joint type.

4. Stainless-Steel Tubing:

    a. Seamless Type 316 stainless steel, Grade TP, cold drawn, annealed and pickled, free from scale.
    b. Chemical and physical properties according to ASTM A 269.
    c. Diameter, as required by application, of not less than nominal 0.25 inch.

5. Stainless-Steel Tubing Connectors and Fittings:

a. Connectors and fittings shall be stainless steel, with stainless-steel collets, flareless type.
b. Connect instruments to tubing with connectors having compression connector on one end and IPS or NPT thread on other end.

2.22 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 18 AWG.
2. Conductor shall be 7/24 soft annealed copper strand.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.
6. Cable shall be plenum rated where installed in return air plenums.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
3. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
4. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
5. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
6. Furnish wire on spools.
7. Cable shall be plenum rated when installed in return air plenums.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 22 AWG.
2. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
3. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
4. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
5. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
6. Furnish wire on spools.
7. Cable shall be plenum rated when installed in return air plenums.

D. LAN and Communication Cable: Comply with BAS manufacturer requirements for network being installed.

1. Cable shall be balanced twisted pair.
2. Comply with the following requirements and for balanced twisted pair cable described in Division 26 – Electrical.

a. Cable shall be plenum rated.
b. Cable shall have a unique color that is different from other cables used on Project.

2.23 RACEWAYS, FIBER OPTICS AND CONNECTORS

A. Comply with requirements in Division 26 and 27.

2.24 ACCESSORIES

A. Pressure Electric Switches:

1. Diaphragm-operated snap acting switch.
2. Set point adjustable from 3 to 20 psig.
3. Differential adjustable from 2 to 6 psig.
4. Rated for resistance loads at 120-V ac.
5. Body and switch housing shall be metal.

B. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

C. I/P and E/P Transducers:

1. Commercial Grade:

a. The transducer shall convert an AO signal to a stepped pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig pneumatic signal for pneumatic actuation.
b. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
c. Transducer shall have auto/manual output switch, manual output control and an output pressure gage.
d. Accuracy: Within 1.0 percent of the output span.
e. Linearity: Within 0.5 percent of the output span.
f. Output Capacity: Not less than 550 scim at 15 psig.
g. Transducer shall have separate zero and span calibration adjustments.
h. The transducer shall withstand up to 40 psig of supply pressure without damage.
i. For use on only modulating pneumatic outputs that are associated with terminal units, including fan-coil units, VAV units, and unit heaters.

D. E/P Switch:

1. Construct the body of cast aluminum or brass; three pipe body (common, normally open, and normally closed).
2. Internal construction of steel, copper or brass.
3. Air Connections: Barb.
4. Rating of 30 psig when installed in systems below 25 psig.
5. Include coil transient suppression.

E. Instrument Enclosures:

1. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.

2. NRTL listed and labeled to UL 50.
3. Sized to include at least 25 percent spare area on subpanel.
4. Instrument(s) mounted within enclosure on internal subpanel(s).
5. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
6. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
7. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
8. Equip enclosure with lock and common key.

F. Manual Valves:

1. Needle Type:

   a. PTFE packing.
   b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
   c. Aluminum T-bar handle.
   d. Include tubing connections.

2. Ball Type:

   a. Body: Bronze ASTM B 62 or ASTM B 61.
   b. Ball: Type 316 stainless steel.
   c. Stem: Type 316 stainless steel.
   d. Seats: Reinforced PTFE.
   e. Packing Ring: Reinforced PTFE.
   f. Lever: Stainless steel with a vinyl grip.
   g. 600 WOG.
   h. Threaded end connections.

2.25 IDENTIFICATION

A. Control Equipment, Instruments, and Control Devices:

1. Self-adhesive label, laminated acrylic or melamine plastic sign bearing unique identification.

   a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

B. Equipment Warning Labels:

1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."

4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BAS INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. BAS shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.

B. Communication Interface to Other Building Systems:

1. BAS shall have a communication interface with systems having a communication interface.

3.3 BAS SYSTEM INTERFACE WITH EXISTING SYSTEMS

A. Interface with Existing Systems:

1. BAS shall interface existing systems to achieve integration.
2. Integration of Existing Control System into BAS:
   a. Existing control system performance requirements shall be satisfied when monitoring and controlling existing control system through BAS.
   b. Operator shall be able to upload, download, monitor, alarm, report, trend, control and program every input and output point in existing system from DDC system using operator workstations and software provided. The combined systems shall share one database.

c. Interface of existing control system I/O points into BAS shall be transparent to operators. All operational capabilities shall be identical regardless of whether I/O already exists or I/O is being installed.

3.4 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. BAS control dampers, airflow sensors and switches, and pressure sensors.

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. BAS control valves, flow meters; pipe-mounted sensors, switches and transmitters; tank-mounted sensors, switches and transmitters; pipe- and tank-mounted thermos-wells.

3.5 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. When applicable, deliver control devices to air-handling or terminal unit equipment manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer. Control devices may include, but are not limited to: Application specific controllers, control valves and dampers, actuators, sensors, switches, transmitters, and relays.

3.6 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop Penetrations made in fire-rated assemblies shall comply with requirements in applicable specification section covering penetration of fire-stopping.

G. Seal penetrations made in acoustically rated assemblies.

H. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

I. Corrosive Environments:

1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

   a. Laboratory exhaust-air streams.
   b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Division 26.
3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.7 WORKSTATION INSTALLATION

A. Desktop Workstations Installation:

1. Install workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.
4. Develop project-specific graphics, trends, reports, logs and historical database.

B. Portable Workstations Installation:

1. Turn over portable workstations to Owner at Substantial Completion.
2. Install software on workstation(s) and verify software functions properly.

C. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Refine graphics as necessary for Owner acceptance.

3.8 SERVER INSTALLATION

A. Install server(s) at location(s) directed by Owner.

B. Install number of servers required to suit requirements indicated. Review Project requirements and indicate layout of proposed location in Shop Drawings.

C. Install software indicated on server(s) and verify that software functions properly.

D. Develop Project-specific graphics, trends, reports, logs, and historical database.

3.9 GATEWAY INSTALLATION

A. Install gateways if required for BAS system communication interface requirements indicated.

1. Install gateway(s) required to suit indicated requirements.

B. Test gateway to verify that communication interface functions properly.

3.10 ROUTER INSTALLATION

A. Install routers if required for BAS system communication interface requirements indicated.

1. Install router(s) required to suit indicated requirements.

B. Test router to verify that communication interface functions properly.

3.11 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network and Programmable Application Controllers:

1. Quantity and location of network controllers shall be determined by BAS manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.

F. Application-Specific Controllers:

1. Quantity and location of application-specific controllers shall be determined by BAS manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.12 INSTALLATION OF WIRELESS ROUTERS FOR OPERATOR INTERFACE

A. Install wireless routers to achieve optimum performance and best possible coverage.

B. Mount wireless routers in a protected location that is within 60 inches of floor and easily accessible by operators.

C. Connect wireless routers to field power supply and to UPS units if network controllers are powered through UPS units.

D. Install wireless router with latest version of applicable software and configure wireless router with WPA2 security and password protection. Create access password with not less than 12 characters consisting of letters and numbers and at least one special character. Document password in operations and maintenance manuals for reference by operators.

E. Test and adjust wireless routers for proper operation with portable workstation and other wireless devices intended for use by operators.

3.13 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Relays.
5. Accessories.
6. Instruments.

B. Attach wall-mounted enclosures to indoor wall using painted steel struts and hardware. Use stainless-steel strut and hardware for mounting enclosures located outdoors.

C. Align top or bottom of adjacent enclosures.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using galvanized or stainless steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.14 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to BAS products requiring electrical power connections.

B. Coordinate location of all electrical power drops to products with Electrical Contractor.

3.15 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

B. Install self-adhesive labels laminated acrylic or melamine plastic signs with unique identification on face for each of the following:

1. Gateway.
2. Router.
3. Protocol analyzer.
4. BAS controllers.
5. Enclosures.

C. Install instrument identification on face of each instrument connected to a BAS controller.

D. Warning Labels and Signs:

1. Shall be permanently attached to equipment that can be automatically started by BAS.
2. Shall be located in highly visible location near power service entry points.

3.16 NETWORK INSTALLATION

A. Install optical fiber cable when connecting between the following network devices and when located in different buildings on campus and Owners fiber is not available for BAS use.

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

B. Install balanced twisted pair or optical fiber cable when connecting between the following network devices located in same building:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

C. Install balanced twisted pair or copper cable (as required by equipment) when connecting between the following:

1. Gateways.
2. Gateways and network controllers or programmable application controllers.
3. Routers.
4. Routers and network controllers or programmable application controllers.
5. Network controllers and programmable application controllers.
6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.
8. Application-specific controllers.

D. Install cable in continuous raceway.

1. When pre-approved or where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.17 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:

a. Every network device shall have an assigned and documented MAC address unique to its network.
b. Ethernet Networks: Document MAC address assigned at its creation.
c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

a. Assign unique numbers to each new network.
b. Provide ability for changing network number through device switches or operator interface.
c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

a. Assign unique device object identifier property numbers or device instances for each device network.
b. Provide for future modification of device instance number by device switches or operator interface.
c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

a. Device object name property field shall support 32 minimum printable characters.
b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

a. Object name property field shall support 32 minimum printable characters.
b. Assign object name properties with plain-English names descriptive of application.

1) Example 1: "Zone 1 Temperature."
2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

a. Assign object identifier property numbers according to **[Drawings] [or] [tables]** indicated.
b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.18 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NEMA 1.

B. Wire and Cable Installation:

1. Comply with installation requirements of Divisions 26 and 27 when applicable.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.

a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

3. Terminate wiring in a junction box.

    a. Clamp cable over jacket in junction box.
    b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

4. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
5. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
6. Use shielded cable to transmitters.
7. Use shielded cable to temperature sensors.
8. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:

1. Comply with applicable sections of Division 26 and 27.

3.19 BAS SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. Control Damper Checkout:

1. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
2. Verify that control dampers are installed correctly for flow direction.
3. Verify that proper blade alignment, either parallel or opposed, has been provided.
4. Verify that damper frame attachment is properly secured and sealed.
5. Verify that damper actuator and linkage attachment is secure.
6. Verify that actuator wiring is complete, enclosed and connected to correct power source.
7. Verify that damper blade travel is unobstructed.

F. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that valve ball, disc or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

G. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

    a. Verify sensing element type and proper material.
    b. Verify length and insertion.

3.20 BAS SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

P. Switches: Calibrate switches to make or break contact at set points indicated.

Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.21 BAS CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.

6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.22 BAS CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:

1. Test every I/O point connected to BAS controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:

    a. Upper quarter of range.
    b. Lower quarter of range.
    c. At midpoint of range.

8. Exercise each binary point.
9. For every I/O point in BAS, read and record each value at operator workstation, at BAS controller and at field instrument simultaneously. Value displayed at operator workstation, at BAS controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in BAS and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.23 BAS SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required BAS system components, wiring, and accessories are installed.

5. Installed BAS system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. BAS system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of BAS system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in BAS.

    a. Verify analog I/O points at operating value.
    b. Make adjustments to out-of-tolerance I/O points.

        1) Identify I/O points for future reference.
        2) Simulate abnormal conditions to demonstrate proper function of safety devices.
        3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of BAS to establish desired conditions.
4. After 24 Hours following Initial Validation Test:

a. Re-check I/O points that required corrections during initial test.
b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:

a. Re-check I/O points that required corrections during second test.
b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that BAS performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. BAS Network Bandwidth Test:

1. Test network bandwidth usage on all BAS networks to demonstrate bandwidth usage under BAS normal operating conditions and under simulated HLC.
2. To pass, none of BAS system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.24 BAS WIRELESS NETWORK VERIFICATION

A. BAS Installer shall design wireless BAS networks to comply with performance requirements indicated.

B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.

C. Testing and verification of all wireless devices shall include, but not be limited to, the following:

1. Speed.
2. Online status.
3. Signal strength.

3.25 FINAL REVIEW

A. Submit written request to Engineer, General Contractor or Construction Manager when BAS is ready for final review. Written request shall state the following:

1. BAS has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. BAS has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. BAS monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. BAS is complete and ready for final review.

B. Review by Engineer, and General Contractor or Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, BAS manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by BAS manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals when no deficiencies are reported.

F. A part of BAS final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with BAS installed to demonstrate operation of BAS during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of BAS that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:

    a. Accuracy and calibration of I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
    b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation.
    c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
    d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
    e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
    f. Trends, summaries, logs and reports set-up for Project.
    g. For HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
    h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
    i. Software's ability to edit control programs off-line.
    j. Data entry to show Project-specific customizing capability including parameter changes.
    k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
    l. Execution of digital and analog commands in graphic mode.
    m. Spreadsheet and curve plot software and its integration with database.
    n. Online user guide and help functions.
    o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
    p. System speed of response compared to requirements indicated.
    q. For each Network and Programmable Application Controller:

        1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.

2) Operator Interface: Ability to connect directly to each type of digital controller with a portable workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
4) Electric Power: Ability to disconnect any controller safely from its power source.
5) Wiring Labels: Match control drawings.
6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

r. For Each Operator Workstation:

1) I/O points lists agree with naming conventions.
2) Graphics are complete.
3) UPS unit, if applicable, operates.

s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:

a) Display of network device status.
b) Display of BACnet Object Information.
c) Silencing devices transmitting erroneous data.
d) Time synchronization.
e) Remote device re-initialization.

f) Backup and restore network device programming and master database(s).
g) Configuration management of routers.

3.26 ADJUSTING

A. Occupancy Adjustments: When requested within 12-months from 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.

3.27 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12- months' full maintenance by BAS manufacturer's authorized service representative. Include preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.28 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at end of warranty period (one year from Substantial Completion), include in your bid a service agreement that shall include software support for two year(s).

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within during the warranty period at no cost to Owner. Upgrading software shall include operating system and new or revised licenses for using software.

3.29 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain BAS.

B. Extent of Training:

1. Base extent of training on scope and complexity of BAS indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

    a. Provide not less than 8-hours of initial training. This training shall not be counted as the time spent with owner during start-up, testing, or demonstration.
    b. After three months, provide an additional 4-hours of dedicated training to review system operations with the Owner, and answer owner questions about operation of the BAS or mechanical components.
    c. At approximately 9 to 10-months from the substantial completion, provide 4 additional hours of Owner training. Prior to conducting the training, contact the owner and request in writing a list of questions or concerns the Owner has on the operation or use of the BAS controls. Use this training as a means to specifically

answer any questions and run through a refresher of how the system operates and BAS capabilities as far as trending, scheduling, etc.

C. Training Schedule:

1. Schedule training with Owner at least 10-business days before expected Substantial Completion.
2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training session, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:

1. Plan in advance of training for at least three attendees.
2. Make allowance for Owner to add up to two attendee(s) at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.
4. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have a high school degree and only the basic user knowledge of computers and office applications, basic knowledge of HVAC systems, and little knowledge of BAS.
5. Provide each attendee with a color hard copy of all training materials and visual presentations.

F. Instructor Requirements:

1. Instructors shall have not less than two years of providing instructional training on not less than five past projects with similar BAS scope and complexity to system installed.

G. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with BAS shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

H. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding BAS architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by BAS including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Logging on and off system.
6. Accessing graphics, reports and alarms.
7. Adjusting and changing set points and time schedules.
8. Recognizing BAS malfunctions.
9. Understanding content of operation and maintenance manuals including control drawings.
10. Understanding physical location and placement of BAS controllers and I/O hardware.
11. Accessing data from BAS controllers.
12. Operating portable operator workstations.
13. Running each specified report and log.
14. Displaying and demonstrating data entry to show Project-specific customizing capability. Demonstrating parameter changes.
15. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
16. Executing digital and analog commands in graphic mode.
17. Demonstrating BAS system performance through trend logs and command tracing.
18. Demonstrating on-line user guide, and help function and mail facility.
19. Demonstrating the following for HVAC systems and equipment controlled by BAS:

    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into BAS is able to communicate with BAS controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.

END OF SECTION

CLARIFICATION REQUEST FORM

1

Date: 12/23/25

Wolgast Clarification Request #:_____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: A-1 Glass Co
Contractor Name
Dave Reiser
Contact Name
dave e a1glassllc.net
Email Address
810-686-6150
Phone # Fax #

Bid Division # and Name: Glass + Glazing

CSI Code (If Applicable): _____

Drawing #: _____ Detail or Item #: _____

Reason for Request: ☑ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each Item)
Please review and respond to the following item(s) for clarification:

No Spec on Window Film

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

Solar Guard Armor Coat 8 mm security film
or approved equal

Construction Manager: _____
Signature Date

Architect: JMK 1/10/26
Signature Date

END OF SECTION 00310

CLARIFICATION REQUEST FORM

2

Date: 12/23/25

Wolgast Clarification Request #:_____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: A-1 Glass Co
Contractor Name

Dave Reiser
Contact Name

dave@a1glassllc.net
Email Address

810-686-6150
Phone # Fax #

Bid Division # and Name: Glass & Glazing

CSI Code (If Applicable): _____

Drawing #: _____ Detail or item #: _____

Reason for Request: ☑ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

No Spec on Fire Rated Glass

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

MFR OPEN, PROVIDE AS REQUIRED TO MEET CODE REQUIRED FIRE RATINGS

Construction Manager: _____ Date
Signature

Architect: JMK 1/10/26
Signature Date

END OF SECTION 00310

CLARIFICATION REQUEST FORM

3

Date: 12/23/25

Wolgast Clarification Request #: _____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: A-1 GLASS Co
Contractor Name
DAVE REISER
Contact Name
davee@a1glassllc.net
Email Address
810-686-6150
Phone # Fax #

Bid Division # and Name: GLASS + GLAZING

CSI Code (if Applicable): _____

Drawing #: _____ Detail or Item #: _____

Reason for Request: ☑ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

NO HARDWARE SCHEDULE

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

SEE FORTHCOMING ADDENDUM

Construction Manager: _____
Signature Date

Architect: JMK 1/10/26
Signature Date

END OF SECTION 00310

CLARIFICATION REQUEST FORM

4

Date: 12.29.2025

Wolgast Clarification Request #:_____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: Contractor Name: Traverse City Glass
Contact Name: Tom Van Nes
Email Address: tomv@traversecityglass.com
Phone # 231.941.2345 Fax # 231.941.9592

Bid Division # and Name: 084000-Glass & Glazing

Drawing #: A5.0 Detail or Item #: FILM 7

Reason for Request: ☐ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: Bangor Township School District

Site Location: 2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

Regarding Typical Note on Sheet A5.0 "Include Impact Resistant Security Film at all Exterior glazing -windows and sidelights."

1. What Scope of work is responsible for this Impact Resistant Security Film ?
2. If by 084000-Glass and Glazing -Is a specification available?
3. Will this film be expected at Existing Windows and Sidelites also?

RESPONSE: ☐ ITEM TO BE INCLUDED IN ADDENDUM

SEE RESPONSE TO RFI #1 / FORTHCOMING ADDENDUM

Construction Manager: _____
Signature Date

Architect: JMK 011026
Signature Date

END OF SECTION 00310

5

CLARIFICATION REQUEST FORM

Date: 12.29.2025

Wolgast Clarification Request #: _____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: Contractor Name: Traverse City Glass
Contact Name: Tom Van Nes
Email Address: tomv@traversecityglass.com
Phone # 231.941.2345 Fax # 231.941.9592

Bid Division # and Name: 084000-Glass & Glazing

Drawing #: N/A Detail or Item #: Scope of Work

Reason for Request: ☐ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: Bangor Township School District

Site Location: 2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

Where can the Specification 087100-Door Hardware be found? If this specicfication has not been released yet, when will we see it?

RESPONSE: ☐ ITEM TO BE INCLUDED IN ADDENDUM

SEE FORTHCOMING ADDENDUM

Construction Manager: _____
Signature Date

Architect: JMK 01/10/26
Signature Date

END OF SECTION 00310

RFI detail

#7 Kawkawlin Roofing - remove membrane

Status	**Open** In Review
Created on	Jan 9, 2026 by **Lisa Donahue** (WOLGAST CORPORATION)
RFI type	Default RFI workflow
Ball in court	**Shannon Derocher** (INTEGRATED DESIGNS, INC)
Due date	-

Question

Is the intent to remove the membrane, insulation, and built-up roofing down to the deck?

It will save the district a lot of money if we simply remove the membrane, leave the insulation, inspect for wet insulation, and provide a price to replace wet insulation based on a board foot or square foot price. Then go back over with enough insulation to achieve the energy code of R-30 and adhere the new membrane.

References and Attachments

PLEASE PROVIDE VOLUNTARY ALTERNATE COST FOR THE ALTERNATE SOLUTION AT BID, IF BUILDING INSPECTOR ALLOWS EXISTING INSULATION TO REMAIN, LIKELY TO PURSUE THIS ROUTE.

JMK 01/10/26

Files (1)

- RFI 7-8 Kawkawlin Roofing.pdf

Impact

Cost impact	-
Schedule impact	-

Other attributes

Priority	Normal
Discipline	-
Category	-

Location	-
Location details	-
External ID	-
Co-reviewer(s)	**Derek Rickett** (WOLGAST CORPORATION) **dblossom dblossom** (WOLGAST CORPORATION) **Julia Krieger** (INTEGRATED DESIGNS, INC)
Construction Phase	Pre-Bid
Spec Section	-

Activities	By	At
Lisa Donahue added a reference to a File **RFI 7-8 Kawkawlin Roofing.pdf**	**Lisa Donahue**	Jan 9, 2026, 11:40 AM EST
Lisa Donahue (WOLGAST CORPORATION) created this RFI in **Open** In Review status and set Ball in court to **Shannon Finnila** (INTEGRATED DESIGNS, INC).	**Lisa Donahue**	Jan 9, 2026, 11:40 AM EST

Lisa Donahue

From: Dave <dave@kawkawlinroofing.com>
Sent: Thursday, January 8, 2026 12:40 PM
To: Derek Rickett; Lisa Donahue
Subject: RE: phase 4 John Glenn Roofing RFI

8

Good afternoon, I have another question.

Under the roofing 07500 Division inclusions it shows the roofing contractor responsible to furnish and install pipe stands for mechanical and electrical trades. Is this the intention or is the mechanical and electrical contractors responsible for their own pipe supports?

Thanks,
Dave Arthur
Vice President – Senior Operations Manager
Kawkawlin Roofing Co. | Phone: 989.684.0561 | Cell: 989.450.1114
Dave@kawkawlinroofing.com
2924 Old Kawkawlin Rd. PO Box 538, Kawkawlin, MI. 48631

From: Dave
Sent: Thursday, January 8, 2026 8:28 AM
To: 'drickett@wolgast.com' <drickett@wolgast.com>; Lisa Donahue <ldonahue@wolgast.com>
Subject: phase 4 John Glenn Roofing RFI

7

Is the intent to remove the membrane, insulation, and built-up roofing down to the deck?

It will save the district a lot of money if we simply remove the membrane, leave the insulation, inspect for wet insulation, and provide a price to replace wet insulation based on a board foot or square foot price. Then go back over with enough insulation to achieve the energy code of R-30 and adhere the new membrane.

Dave Arthur
Vice President – Senior Operations Manager
Kawkawlin Roofing Co. | Phone: 989.684.0561 | Cell: 989.450.1114
Dave@kawkawlinroofing.com
2924 Old Kawkawlin Rd. PO Box 538, Kawkawlin, MI. 48631

RFI detail

#9 Wm Bronner - 5 questions

Status	**Open** In Review
Created on	Jan 9, 2026 by **Lisa Donahue** (WOLGAST CORPORATION)
RFI type	Default RFI workflow
Ball in court	**Shannon Derocher** (INTEGRATED DESIGNS, INC) **Derek Rickett** (WOLGAST CORPORATION)
Due date	-

Question

see attached email with questions

References and Attachments

Files (1)

- RFI 9 Wm Bronner.pdf

Impact

Cost impact	-
Schedule impact	-

Other attributes

Priority	Normal
Discipline	-
Category	-
Location	-
Location details	-

External ID	-
Co-reviewer(s)	-
Construction Phase	Pre-Bid
Spec Section	-

Activities	By	At
Lisa Donahue added a reference to a File **RFI 9 Wm Bronner.pdf**	**Lisa Donahue**	Jan 9, 2026, 11:47 AM EST
Lisa Donahue (WOLGAST CORPORATION) created this RFI in **Open** In Review status and set Ball in court to **Shannon Finnila** (INTEGRATED DESIGNS, INC), **Derek Rickett** (WOLGAST CORPORATION).	**Lisa Donahue**	Jan 9, 2026, 11:47 AM EST

Lisa Donahue

From: Grant Bronner <grant@bronnerconstruction.com>
Sent: Thursday, January 8, 2026 1:45 PM
To: Derek Rickett
Cc: Lisa Donahue
Subject: P4 John Glenn High school renovations

9

Afternoon Derek,

Had a couple quick questions that I am hoping you could help answer for me.

1. Will there be an addendum coming out with the hardware schedule?
2. I know the Marker/tack boards have no spec but the prints are pretty vague, will more information be coming out on these as well?
3. Will all demo work excluding MEP removal be under the general trades contract? Masonry, concrete, flooring, ect...
    a. Is there a way to know existing wall types? Specifically in area B. I'm assuming drywall and metal studs but would like to be certain.
4. Will full cleaning services be required of the GT?
5. The schedule on the project manual has the demo starting June 1 but I recall hearing the job was supposed to start right away at the walk through. Please confirm.

Thank you,

Grant Bronner
Wm. Bronner & Son Contr. Inc
393 List St.
Frankenmuth, MI 48734
Ph: 989-652-3229
Cell:989-297-8497

1. YES
2. YES, SPEC TO BE INCLUDED IN ADDENDUM
3. AREA B IS PRIMARILY CMU WALLS, SEE DEMO PLANS. FIELD INSPECTION IS EXPECTED FOR BIDDERS. LIMITED STUD/DRYWALL DEMOLITION AS WELL.
4. WOLGAST TO ANSWER
5. WOLGAST TO ANSWER.

JMK 01/10/26

RFI detail

#11 Gilmour - hardware sets

Status	**Open** In Review
Created on	Jan 12, 2026 by **Lisa Donahue** (WOLGAST CORPORATION)
RFI type	Default RFI workflow
Ball in court	**Shannon Derocher** (INTEGRATED DESIGNS, INC)
Due date	-

Question

see attached

References and Attachments

Files (1)

- RFI 11 Gilmore - hardware sets.pdf

Impact

Cost impact	-
Schedule impact	-

Other attributes

Priority	Normal
Discipline	-
Category	-
Location	-
Location details	-

External ID	-
Co-reviewer(s)	**Derek Rickett** (WOLGAST CORPORATION) **dblossom dblossom** (WOLGAST CORPORATION) **Julia Krieger** (INTEGRATED DESIGNS, INC)
Construction Phase	Pre-Bid
Spec Section	-

Activities	By	At
Lisa Donahue added a reference to a File **RFI 11 Gilmore - hardware sets.pdf**	**Lisa Donahue**	Jan 12, 2026, 3:18 PM EST
Lisa Donahue (WOLGAST CORPORATION) created this RFI in **Open** In Review status and set Ball in court to **Shannon Finnila** (INTEGRATED DESIGNS, INC).	**Lisa Donahue**	Jan 12, 2026, 3:18 PM EST

CLARIFICATION REQUEST FORM

Date: 1/12/26

Wolgast Clarification Request #: 9

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: Gilmour Construction Inc.
Contractor Name
Adam Peters
Contact Name
adam@team-gci.com
Email Address
(989)513-6022
Phone # Fax #

Bid Division # and Name: 060000 General Trades

CSI Code (If Applicable): _____

Drawing #: A5.0 Detail or Item #: Hardware Set

Reason for Request: ☑ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

Sheet A5.0 does not indicate any hardware sets, also the spec book is missing section 087100 Door Hardware. Will this be addressed in a forthcoming addendum?

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

Door hardware to be issued in Addendum 2.

Construction Manager: _____ Date
Signature

Architect: _____ 01/15/26
Signature Date

END OF SECTION 00310

RFI detail

#12 Division 7 - coverboard

Status	**Open** In Review
Created on	Jan 12, 2026 by **Lisa Donahue** (WOLGAST CORPORATION)
RFI type	Default RFI workflow
Ball in court	**Shannon Derocher** (INTEGRATED DESIGNS, INC)
Due date	-

Question

Coverboard RFI
a. The specifications 075300 2.3.B calls out a 1/2" Coverboard.
b. The plans / details do not show a coverboard.
c. A3.1 Detail 1 Roof Assembly 'A' states "Coverboard (If required by manufacturer)".
d. Based on the warranty being requested a coverboard should not be required by the manufacturer.
e. Can you please advise if a coverboard is required to be part of the bid for the roofing scope?

References and Attachments

Files (1)

- RFI 12 Roofing Coverboard RFI.pdf

Impact

Cost impact	-
Schedule impact	-

Other attributes

Priority	Normal
Discipline	-
Category	-

Location	-
Location details	-
External ID	-
Co-reviewer(s)	**Derek Rickett** (WOLGAST CORPORATION) **dblossom dblossom** (WOLGAST CORPORATION) **Julia Krieger** (INTEGRATED DESIGNS, INC)
Construction Phase	Pre-Bid
Spec Section	-

Activities	By	At
Lisa Donahue added a reference to a File **RFI 12 Roofing Coverboard RFI.pdf**	**Lisa Donahue**	Jan 12, 2026, 3:23 PM EST
Lisa Donahue (WOLGAST CORPORATION) created this RFI in **Open** In Review status and set Ball in court to **Shannon Finnila** (INTEGRATED DESIGNS, INC).	**Lisa Donahue**	Jan 12, 2026, 3:23 PM EST

CLARIFICATION REQUEST FORM

Date: 1/9/2026

Wolgast Clarification Request #:_____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: Division 7 Building Contractors, Inc.
Contractor Name
Greg Boyle
Contact Name
gregory.boyle@d7bci.com
Email Address
616-795-5375
Phone # Fax #

Bid Division # and Name: 075000 - Roofing

CSI Code (If Applicable): _____

Drawing #: Roof Plans Detail or Item #: 1/A3.1 & 075300 2.3.B

Reason for Request: ☑ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

Coverboard RFI
a.The specifications 075300 2.3.B calls out a 1/2" Coverboard.
b.The plans / details do not show a coverboard.
c.A3.1 Detail 1 Roof Assembly 'A' states "Coverboard (If required by manufacturer)".
d.Based on the warranty being requested a coverboard should not be required by the manufacturer.

Can you please advise if a coverboard is required to be part of the bid for the roofing scope?

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

No coverboard required if not required by manufacturer warranty.

Construction Manager: _____
Signature Date

Architect: _____ 01/15/26
Signature Date

END OF SECTION 00310

RFI detail

#13 Division 7 - existing deck types

Status	**Open** In Review
Created on	Jan 12, 2026 by **Lisa Donahue** (WOLGAST CORPORATION)
RFI type	Default RFI workflow
Ball in court	**Shannon Derocher** (INTEGRATED DESIGNS, INC)
Due date	-

Question

Existing Roof Information
a. Do you have any existing roof reports that have existing roof core and deck information? We are looking for:
i. Cores of each roof section (thickness and existing materials). It would be beneficial if it had pictures of the cores as well.
ii. Existing deck types (metal, tectum, gyp, concrete, etc...)
iii. If the existing deck types are structurally flat or structurally sloped
1. This will help us to understand which sections will need full tapered insulation to get water to the drains.
2. This will help us to understand which type of fasteners (or if we need to use adhesive) to use to attach the insulation.

References and Attachments

Files (1)

- RFI 13 Roofing Deck Types and slope RFI.pdf

Impact

Cost impact	-
Schedule impact	-

Other attributes

Priority	Normal

Discipline	-
Category	-
Location	-
Location details	-
External ID	-
Co-reviewer(s)	**Derek Rickett** (WOLGAST CORPORATION) **dblossom dblossom** (WOLGAST CORPORATION) **Julia Krieger** (INTEGRATED DESIGNS, INC)
Construction Phase	Pre-Bid
Spec Section	-

Activities	By	At
Lisa Donahue added a reference to a File **RFI 13 Roofing Deck Types and slope RFI.pdf**	**Lisa Donahue**	Jan 12, 2026, 3:25 PM EST
Lisa Donahue (WOLGAST CORPORATION) created this RFI in **Open** In Review status and set Ball in court to **Shannon Finnila** (INTEGRATED DESIGNS, INC).	**Lisa Donahue**	Jan 12, 2026, 3:25 PM EST

CLARIFICATION REQUEST FORM

Date: 1/9/2026

Wolgast Clarification Request #:_____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: Division 7 Building Contractors, Inc.
Contractor Name
Greg Boyle
Contact Name
gregory.boyle@d7bci.com
Email Address
616-795-5375
Phone # Fax #

Bid Division # and Name: 075000 - Roofing

CSI Code (If Applicable): _____

Drawing #: _____ Detail or Item #: _____

Reason for Request: ☐ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

Existing Deck Types and if they deck slope
Do you have any structural plans or drawings or any other reports that would provide the existing deck types (metal, tectum, gyp, concrete, etc...) and show if the existing deck types are structurally flat or structurally sloped?
This will help us to understand which sections will need full tapered insulation to get water to the drains.
This will help us to understand which type of fasteners (or if we need to use adhesive) to use to attach the insulation.

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

Original construction documents for the building can be provided for reference.

Construction Manager: _____
Signature Date

Architect: _____ 01/15/26
Signature Date

END OF SECTION 00310

RFI detail

#15 Division 7 - roof core

Status	**Open** In Review
Created on	Jan 12, 2026 by **Lisa Donahue** (WOLGAST CORPORATION)
RFI type	Default RFI workflow
Ball in court	**Shannon Derocher** (INTEGRATED DESIGNS, INC)
Due date	-

Question

Existing Roof Information
a. Do you have any existing roof reports that have existing roof core and deck information? We are looking for:
i. Cores of each roof section (thickness and existing materials). It would be beneficial if it had pictures of the cores as well.
ii. Existing deck types (metal, tectum, gyp, concrete, etc...)
iii. If the existing deck types are structurally flat or structurally sloped
1. This will help us to understand which sections will need full tapered insulation to get water to the drains.
2. This will help us to understand which type of fasteners (or if we need to use adhesive) to use to attach the insulation.

References and Attachments

Files (1)

- RFI 15 Roofing Core Information RFI.pdf

Impact

Cost impact	-
Schedule impact	-

Other attributes

Priority	Normal

Discipline	-
Category	-
Location	-
Location details	-
External ID	-
Co-reviewer(s)	**Derek Rickett** (WOLGAST CORPORATION) **dblossom dblossom** (WOLGAST CORPORATION) **Julia Krieger** (INTEGRATED DESIGNS, INC)
Construction Phase	Pre-Bid
Spec Section	-

Activities	By	At
Lisa Donahue added a reference to a File **RFI 15 Roofing Core Information RFI.pdf**	**Lisa Donahue**	Jan 12, 2026, 4:06 PM EST
Lisa Donahue (WOLGAST CORPORATION) created this RFI in **Open** In Review status and set Ball in court to **Shannon Finnila** (INTEGRATED DESIGNS, INC).	**Lisa Donahue**	Jan 12, 2026, 4:06 PM EST

CLARIFICATION REQUEST FORM

Date: 1/9/2026

Wolgast Clarification Request #:_____

To: Wolgast Corporation
Derek Rickett (drickett@wolgast.com)
4835 Towne Centre Road, Suite 203
Saginaw, MI 48604
Phone (989) 790-9120, Fax (989) 790-9063

From: Division 7 Building Contractors, Inc.
Contractor Name
Greg Boyle
Contact Name
gregory.boyle@d7bci.com
Email Address
616-795-5375
Phone # Fax #

Bid Division # and Name: 075000 - Roofing

CSI Code (If Applicable): _____

Drawing #: _____ Detail or Item #: _____

Reason for Request: ☐ More Detail Needed ☐ Engineering Clarification ☐ Alternate Proposal ☐ Other

Project: **Bangor Township School District**

Site Location: **2023 Bond - Phase 4 - John Glenn High School Reno. and Site Work**

ITEM(S) FOR CLARIFICATION OF BID: (Please use one form for each item)
Please review and respond to the following item(s) for clarification:

Existing Roof Information
Do you have any existing roof reports that have existing roof core information? We are looking for Cores of each roof section (thickness & type of existing materials along with deck type). It would be beneficial if it had pictures of the cores as well.

RESPONSE: ☐ **ITEM TO BE INCLUDED IN ADDENDUM**

We do not have existing roof reports, however former asbuilt and construction documents will be made available for reference

Construction Manager: _____
Signature Date

Architect: _____ 01/15/26
Signature Date

END OF SECTION 00310

WOLGAST CORPORATION

PRE–BID MEETING

Bangor Township Schools

2023 Bond - Phase 4 - John Glenn High School Renovations and Site Work

PRE-BID MEETING AGENDA

Wednesday, January 7, 2026, at 10:30 AM

1. **Introductions:**
   - a. **Owner Rep:** Matt Schmidt- Bangor Twp Sch– Superintendent
     Kurt Pake, Bangor Twp Sch - Facility Director
   - b. **Construction Manager:** Derek Rickett, Wolgast Corporation – Project Manager
     Dan Blossom, Wolgast Corporation – Field Manager
   - **c. Architect:** Julia Krieger- Integrated Designs, Inc.– Architect

2. **Project Scope:**

03 01 00 – Concrete
04 00 00 – Masonry
05 00 00 - Metals
06 00 00 – General Trades
07 50 00 – Roofing
08 40 00 – Glass & Glazing
09 10 00 – Drywall, Insulation and Acoustical
09 65 00 – Flooring
09 90 00 – Painting
12 30 00 – Casework
22 23 00 – Plumbing & HVAC
26 00 00 - Electrical
31 00 00 – Site Work

3. **Contractor Bid Proposals:**
   - a. Sealed bids for this project are due no later than: **Thursday, January 15, 2026@ 3:00 PM**
     Proposals may be mailed or delivered in person to:
     Matt Schmidt, Superintendent
     Bangor Township Schools
     3359 E Midland Road
     Bay City, MI 48706

     All bids will be opened and read aloud at approximately 3:10 PM at the Administration Office.

     Electronic Sealed bids may also be submitted using Building Connected see below link.
     https://app.buildingconnected.com/login?retUrl=%2F

     If you want to listen in during the bidding process, please use TEAMS
     Meeting ID: 240 206 452 617 14 Passcode: 7sM9Yq99

   - b. The successful bidder will be “prime” contractor having a contract directly with the Bangor Township Schools.
   - c. Familial Relationship Affidavit – Section 00306 of Spec Book.
   - d. Iran Economic Sanctions Act – Section 00307 of Spec Book

4. **Addenda:**
    a. The Architect will issue any and all addenda.
    b. Last day to submit addendum questions will be Thursday, January 8, 2026.

5. **Milestone Schedule:**
    a. Award of Contracts: It is the intention of Bangor Township Schools to award contracts on or about Monday, January 26, 2026.
    b. The start & completion dates for this project are tentatively set for:
        Start Date: **See Milestone Schedule**
        Completion Date: **See Milestone Schedule**
    a. The Construction Manager will provide a detailed project construction schedule to all contractors based on input received at the post bid interview.

6. **Bonds:**
    a. A five percent (5%) bid security must accompany each bid. Personal or Company checks do not satisfy the bid bond requirement and may be grounds for disqualification of that bid.
    b. All bidders must have the ability to provide Performance Bonds and Labor and Material Payment Bonds. These bonds **may or may not** be requested by the Owner if the awarded proposal amount is less than $50,000.00, but all bids **must include** the cost of the PLM bond regardless of bid amount. All awarded proposal amounts exceeding $50,000.00 must be secured by both performance and payment bonds as required by State law.
    c. The Performance Bond and Labor and Material Payment Bond are to be submitted to the Construction Manager before construction begins.

7. **Inquiries:**
    a. All questions regarding the design, the drawings and the specifications are to be faxed or emailed to: Wolgast Corporation, Attn: Derek Rickett, Project Manager, email: drickett@wolgast.com also copy Lisa Donahue at ldonahue@wolgast.com in the form of a Clarification Request Form. This will be forwarded to the architect for clarification. The Construction Manager **will make no** interpretations of the construction documents.
    b. All questions regarding the bidding procedures (what to bid, how to fill out the proposal form, construction schedules, etc) are to be directed to Wolgast Corporation, Attn: Derek Rickett, Project Manager, Office #: 989-790-9120, or email: drickett@wolgast.com and copy Lisa Donahue at ldonahue@wolgast.com .

8. **Post Bid Procedures:**
    a. Post-Bid interviews will be conducted with the low bidder and in some cases the second low bidder. The interviews will be conducted by the Construction Manager and the Architect. The Owner may elect to be present at the interviews.
    b. The apparent low bidders will be notified the day after the bid of their scheduled interview time.
    c. Bid results will be made available from the Construction Manager.

9. **Questions:**

END OF PRE-BID MEETING AGENDA

Bangor Township Schools

2023 Bond - Phase 4 - John Glenn High School Renovations and Site Work

Pre - Bid Sign In

Wednesday, January 7, 2026

10:30 AM, Gym lobby off bus loop

Wolgast Corporation /Integrated Designs, Inc.

Company (Printed)	**Name** (Printed)	**Phone/Cell**		**Email**
Unlimited Construction	Max Prebenda	734-882-7152		estimate@unltdconst.com
Great Lakes Systems	Fernando Diaz	616-325-9636		fdiaz@weathershieldusa.com
WOBIG CONSTRUCTION	KEVIN ROTH	989-752-1294		WOBIGCONST@SBCGLOBAL.NET
Pumford Construction	Caleb Krueger	989-928-2674		CalebK@pamford.com
Pumford Const.	Mike Langowski	989 751 0661		mikel@pumford.com
Quality Roofing	Frank Stevens	989-239-3307		Estimating@qualityroofinginc.com
Versico	Marc Russell	989 225-0188		russell@Greatlakesroofingsolutions.com
Renova One	Chad Reuth	810-429-6598		Chadreuth@renovaone.com

Bangor Township Schools

2023 Bond - Phase 4 - John Glenn High School Renovations and Site Work

Pre - Bid Sign In

Wednesday, January 7, 2026

10:30 AM, Gym lobby off bus loop

Wolgast Corporation /Integrated Designs, Inc.

Company (Printed)	Name (Printed)	Phone/Cell		Email
Quality Environmetal	Grant Johnston	989 435 2946		info@qes1.com
Spence Brothers	Evan Burrows	989 402 7459		evanburrows@spencebrothers.com
Brown & Son Rfg	Dave LaBrun	9892393849		tbrownson63@gmail.com
Kawkawlin Roofing	Dave Arthur	989-450-1114		dave@kawkawlinroofing.com
Eveready Electric	Darren D. Hemker	989-439-9399		Darren.Hemker1@Gmail.com
Johnson Wood	Jeremy Wolfe	9894018990		jeremyw@johnsonwood llc.com
John E Green	Tom Tacey	989 450 7812		Tomtacey@johnegreen.com

Bangor Township Schools

2023 Bond - Phase 4 - John Glenn High School Renovations and Site Work

Pre - Bid Sign In

Wednesday, January 7, 2026

10:30 AM, Gym lobby off bus loop

Wolgast Corporation /Integrated Designs, Inc.

Company (Printed)	**Name** (Printed)	**Phone/Cell**		**Email**
Nelson Electric	Jason Rivette	989-752-7184		Jason@WFNelson.com
Wm Bronner & Son	GRANT BRONNER	989-297-8497		GRANT@BronnerConstruction.com
~~R & S Electric~~	Rollie Chelew	989.893.3200		Rollie@bselectricllc.com
Northeastern Paint	Brandon Ryll	989-890-0105		brandon@northeasternPaint.com
Northeastern Floor	John Niles	810 893 4730		john@northeasternpaint.com
SUGAR Construction	Jerry Brown	989-941-1221		jerrybrown@sugarconstruction.com
Champagne Mtrx Excavating	Chris Schumann	989-239-5679		chris@champagnemarx.com
Tri-City Acoustical	Brandon Tomlinson	989-295-0548		Brandon@tri-cityacoustical.com

ProjectWorks®

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

CEILINGS - DRAWING PACKAGE 12-19-25

PW-02457312 CASE #: 02457959 REV: R1

DRAWING LIST

PRE-CONSTRUCTION ONLY

CUSTOMER APPROVAL: _____

PRE-CONSTRUCTION DRAWINGS REQUIRE CUSTOMER SIGN-OFF BEFORE AN ORDER WILL BE PROCESSED.

DESIGN SERVICE DRAWINGS CANNOT BE USED FOR ORDERING AND DO NOT REQUIRE CUSTOMER SIGN-OFF UNLESS OTHERWISE REQUESTED BY PROJECTWORKS.

FILE TYPE PROVIDED BY CUSTOMER TO CREATE THIS DRAWING PACKAGE: **PDF**

Armstrong World Industries

ProjectWorks

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

PROJECTWORKS DRAWING PACKAGE

PROJECTWORKS NUMBER: PW-02457312

CASE NUMBER: 02457959

DATE FIRST ISSUED: 12-17-25

CAD SPECIALIST NEG

CHECKED BY: XXX

DESCRIPTION: COVER SHEET

FILE TYPE PROVIDED TO PROJECTWORKS: PDF

FIELD VERIFIED DIMENSIONS: NO

REVISIONS

REV: 1	DATE: 12-19-25
REV: 2	DATE: XX-XX-XX
REV: 3	DATE: XX-XX-XX
REV: 4	DATE: XX-XX-XX

DRAWING NO.

C1

TYPICAL DRAWING PACKAGE NOTES

PROJECTWORKS SYMBOL KEY:

Symbol references shown below may appear on the following pages to note specific ceiling conditions.

RED SCREW GUN SYMBOL:
Areas that may require field modification to panels, grid, and/or hardware. See pages labeled "G" at the end of this document for guidance on field modifications. reference the associated product's installation instructions on our website for additional details and guidance.

YELLOW CAUTION SYMBOL:
Areas of possible concern. Examples: Possible hardware clashing, full-sized panels against perimeters, interferences with MEP/HVAC/lighting, etc.

ORANGE WARNING SYMBOL:
Areas with **NO standard solution**. These areas may require **custom** panels, suspension, or hardware components to achieve the desired visual. Please discuss with Armstrong/ProjectWorks before proceeding.**The installing contractor is responsible for resolving any undecided solutions.**

GENERAL NOTES:

1. Electronic copies of the architectural drawings associated with this project were provided to Armstrong for review. This drawing is based on Armstrong's interpretation of the information supplied. This drawing must be checked and approved by the customer.
2. This set of drawings is meant to supplement standard installation and does not act as a replacement of them. The installing contractor is responsible for determining order quantities, scope, and adhering to local building codes. Refer to Armstrong (specific system type) installation instructions for additional information.
3. Dimensions: Drawings, installation details, and finish schedules are based on dimensions and scale from the ceiling (RCP) and wall plan documents supplied to Armstrong. Dimensions listed in the documents provided to Armstrong may not align with field verified dimensions. See title block to the right for status of field verified dimensions.
4. PDF Submissions: If this drawing package was derived from a PDF, there may be discrepancies or inaccurate information on the following pages due to the level of drawing quality and scaling issues found in typical PDFs. Armstrong takes no responsibility for the accuracy of a ProjectWorks drawing package derived from a PDF. Customer is responsible for checking the scaling and accuracy of this drawing.
5. Any quantities listed in the bill of materials and/or finish schedules do not include an allowance for waste, safety stock, and attic stock. Quantities listed are "raw" quantities following Armstrong's interpretation of the drawings provided and recommended installation practices. The optimization analysis and report contained in this drawing set provide guidance on the re-usability of cut perimeter panel scrap. The installing contractor is responsible for determining all final quantities including those listed in the optimization report. Optimized quantities are based on Armstrong's recommended installation practices. Other methods of installation may use more or less material.
6. Contractor is responsible for meeting all local codes for installation.
7. Field-cut panels as required (by installing contractor).
8. All ceiling panel penetrations to be field-cut unless otherwise noted.
9. Armstrong does not support installing full-sized Tegular and Vector panels against wall molding perimeters due to the inconsistency of wall placement and alignment during construction. Ceiling placement should allow for these panels to be cut to size against each wall location with the panel face resting on the molding flange.
10. Unless specifically noted, hanger wire, aircraft cable, and threaded rod locations (with associated hanging hardware) are not detailed or included in this drawing package and any associated finish schedules and bill of materials. Hanging hardware quantities and locations rely on site specific conditions and system installation requirements. Installing contractor to evaluate and add to finish schedule quantities and bill of materials as required.
11. Minor shifts in suspension layout to be handled on-site by the installing contractor. Revision requests to adjust ceiling layouts by fractions of an inch (that do not impact ceiling component quantities) may be rejected.

PROJECT SPECIFIC NOTES

PRE-CONSTRUCTION NOTES:

Panel quantities listed in the finish schedule do not reflect scrap reusability, optimization, attic stock, and/or safety stock. Reference the panel optimization report on the following pages for guidance on optimized panel quantities that consider scrap reusability. Attic stock and safety stock can be added upon order entry.

Armstrong World Industries

ProjectWorks

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

PROJECTWORKS DRAWING PACKAGE

PROJECTWORKS NUMBER:
PW-02457312

CASE NUMBER:
02457959

DATE FIRST ISSUED:
12-17-25

CAD SPECIALIST
NEG

CHECKED BY:
XXX

DESCRIPTION:
NOTES - SYMBOLS - DEFINITIONS

FILE TYPE PROVIDED TO PROJECTWORKS:
PDF

FIELD VERIFIED DIMENSIONS:
NO

REVISIONS

REV: 1	DATE: 12-19-25
REV: 2	DATE: XX-XX-XX
REV: 3	DATE: XX-XX-XX
REV: 4	DATE: XX-XX-XX

DRAWING NO.

N1

Armstrong World Industries Finish Schedule - Pre-Construction

Tag	Category	Description	Color	Item Number	Quantity
ACT-1					
-	Bracket	Suprafine 45° Double Angle Bracket	White	75AB45D	148 PCS
-	Bracket	Suprafine 45° Left Angle Bracket	White	75AB45L	141 PCS
-	Bracket	Suprafine 45° Right Angle Bracket	White	75AB45R	139 PCS
-	Hardware	Beam End Retaining Clip	-	BERC2	295 PCS
-	Hardware	Cross Tee Adapter Clip	-	XTACAG	10 PCS
-	Hardware	Perimeter Angle Clip	-	PAC	23 PCS
D4	Diffuser	9/16" Sq Teg 45° RPG 48" Base - Price Shaped Diffuser	-	By Others	3 PCS
D5	Diffuser	9/16" Sq Teg 45° Tri 48" Base - Price Shaped Diffuser	-	By Others	14 PCS
D6	Diffuser	9/16" Sq Teg 45° LPG 48" Base - Price Shaped Diffuser	-	By Others	2 PCS
P4	Panel	Calla 9/16" Sq Teg 45° Tri 48" Base	White	100100	199 PCS
P5	Panel	Calla 9/16" Sq Teg 45° LPG 48" Base	White	100113	119 PCS
P6	Panel	Calla 9/16" Sq Teg 45° RPG 48" Base	White	100112	115 PCS
LT2	Tee Light	Suprafine 45° 24" Base - JLC Tech - T-Bar Flex LED Light	-	By Others	37 PCS
MB1	Grid	Suprafine 9/16" - 12' ID Main Beam, Routs 6" OC	White	7500	850 LFT
PT1	Grid	Suprafine 24" Base Perimeter Cross Tee	White	XM7524	157 PCS
XT2	Grid	Suprafine 45° 24" Base Cross Tee	White	XM754524	176 PCS
TRM1	Perimeter Trim	12' Hemmed Angle Molding - 7/8" Flange	White	7800	529 LFT

PRE-CONSTRUCTION NOTES:

Panel quantities listed in the finish schedule do not reflect scrap reusability, optimization, attic stock, and/or safety stock. Reference the panel optimization report on the following pages for guidance on optimized panel quantities that consider scrap reusability. Attic stock and safety stock can be added upon order entry.

Hub Schedule

Tag	Part Description	Color	Quantity	Item Number
A	Cross Tee Adapter Clip	-	1	XTACAG
	Perimeter Angle Clip		3	PAC
B	Cross Tee Adapter Clip	-	1	XTACAG
	Perimeter Angle Clip		2	PAC
C	Beam End Retaining Clip	-	1	BERC2
D	Beam End Retaining Clip	-	1	BERC2
E	Beam End Retaining Clip	-	1	BERC2
F	Beam End Retaining Clip	-	1	BERC2
G	Suprafine 45° Double Angle Bracket	White	2	75AB45D
H	Suprafine 45° Double Angle Bracket	White	1	75AB45D
	Suprafine 45° Right Angle Bracket	White	1	75AB45R
I	Suprafine 45° Left Angle Bracket	White	2	75AB45L
J	Suprafine 45° Left Angle Bracket	White	1	75AB45L
	Suprafine 45° Right Angle Bracket	White	1	75AB45R

Armstrong World Industries

ProjectWorks

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

PROJECTWORKS DRAWING PACKAGE

PROJECTWORKS NUMBER:
PW-02457312

CASE NUMBER:
02457959

DATE FIRST ISSUED:
12-17-25

CAD SPECIALIST
NEG

CHECKED BY:
XXX

DESCRIPTION:
MATERIAL SCHEDULES

FILE TYPE PROVIDED TO PROJECTWORKS:
PDF

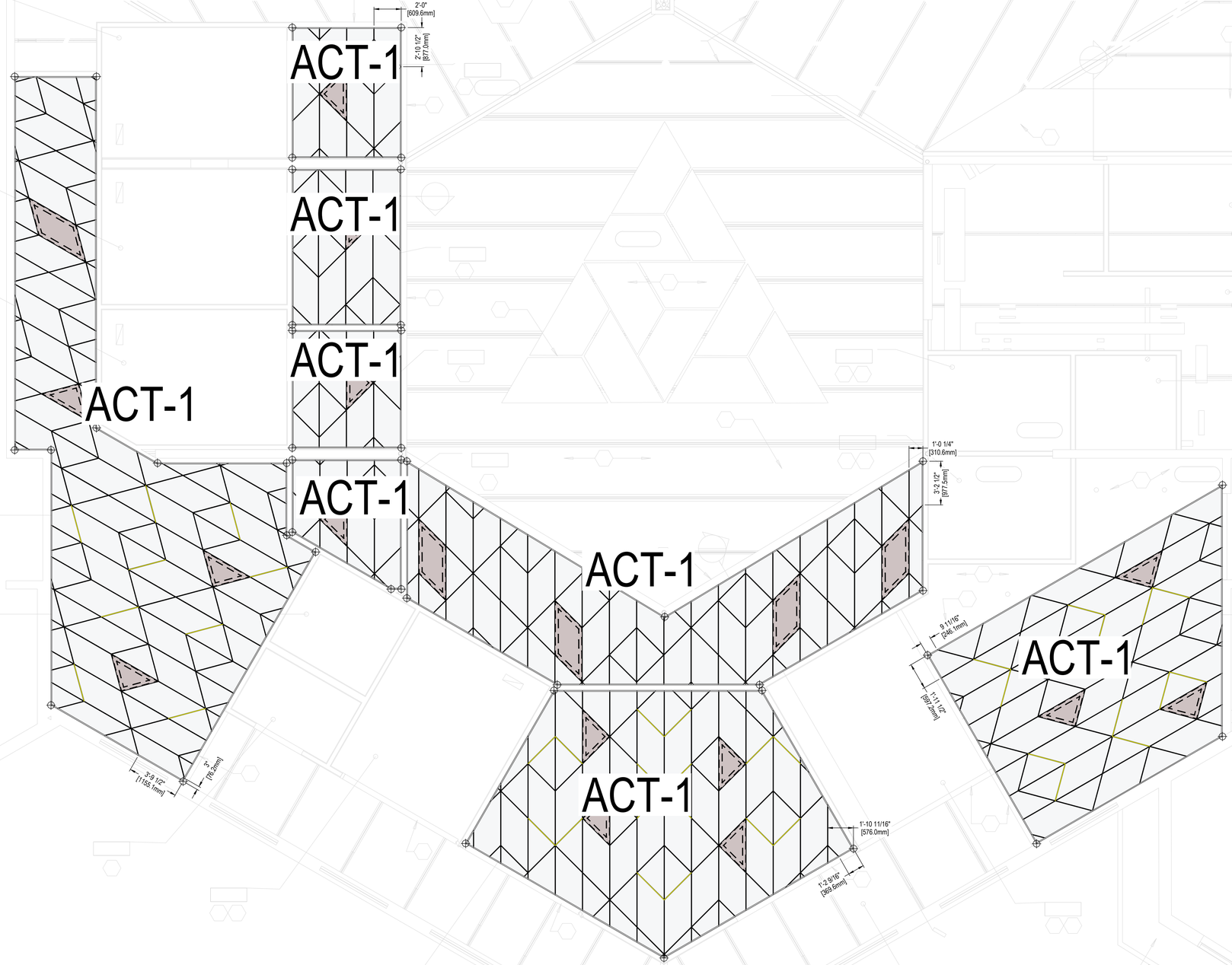
FIELD VERIFIED DIMENSIONS:
NO

REVISIONS

REV: 1	DATE: 12-19-25
REV: 2	DATE: XX-XX-XX
REV: 3	DATE: XX-XX-XX
REV: 4	DATE: XX-XX-XX

DRAWING NO.

T1



1 BANGOR BP4 - ENLARGED REFLECTED CEILING PLAN (CEILING DIMENSIONS AND LAYOUT)
SCALE: 1/4" = 1'-0"

Armstrong World Industries

ProjectWorks

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

PROJECTWORKS DRAWING PACKAGE

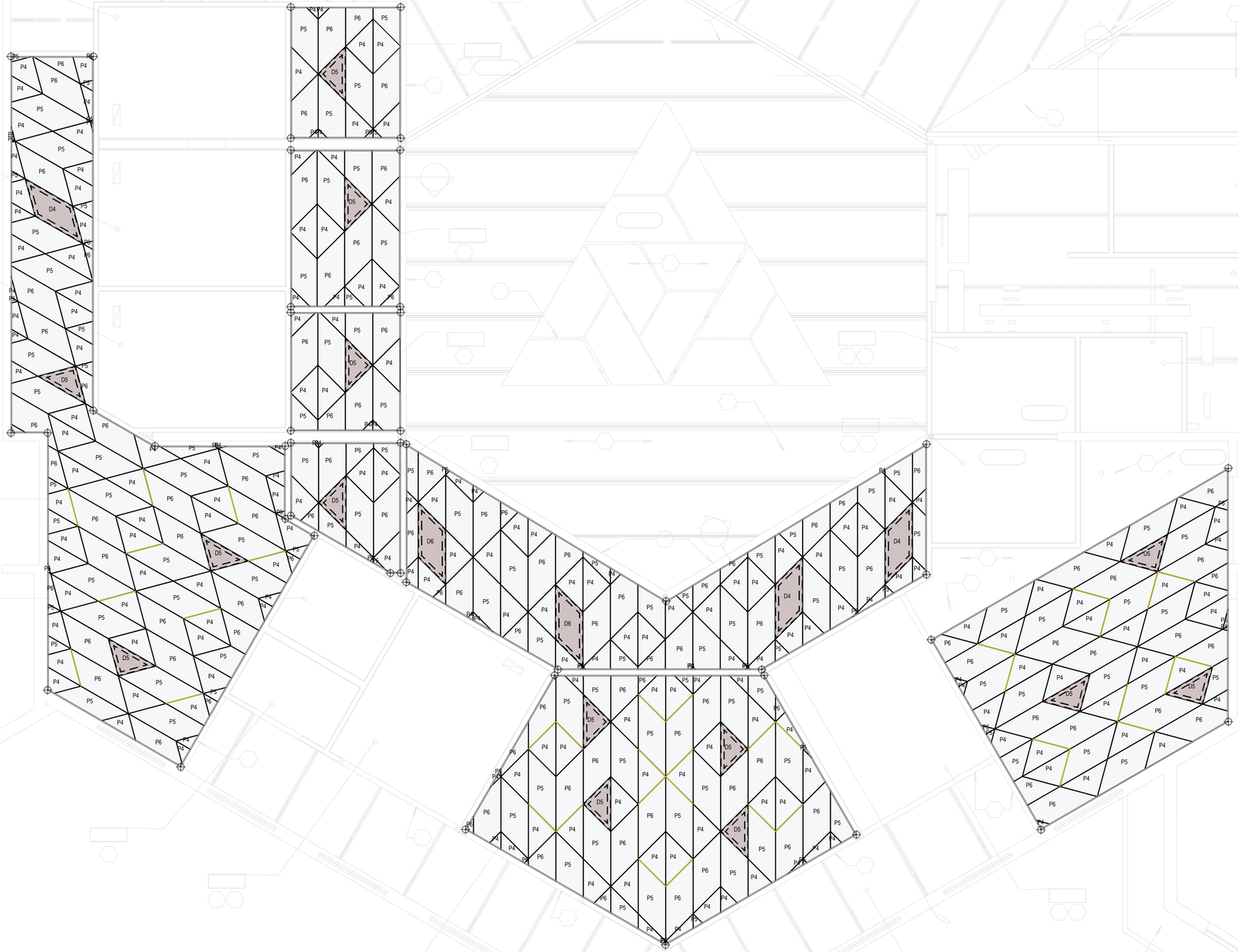
PROJECTWORKS NUMBER:	PW-02457312
CASE NUMBER:	02457959
DATE FIRST ISSUED:	12-17-25
CAD SPECIALIST	NEG
CHECKED BY:	XXX
DESCRIPTION:	ENLARGED REFLECTED CEILING PLAN (CEILING DIMENSIONS AND LAYOUT)
FILE TYPE PROVIDED TO PROJECTWORKS:	PDF
FIELD VERIFIED DIMENSIONS:	NO

REVISIONS

REV: 1	DATE: 12-19-25
REV: 2	DATE: XX-XX-XX
REV: 3	DATE: XX-XX-XX
REV: 4	DATE: XX-XX-XX

DRAWING NO.

R1



1 BANGOR BP4 - ENLARGED REFLECTED CEILING PLAN (PANEL LAYOUT)
SCALE: 1/4" = 1'-0"

Armstrong World Industries

ProjectWorks

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

PROJECTWORKS DRAWING PACKAGE

PROJECTWORKS NUMBER:
PW-02457312

CASE NUMBER:
02457959

DATE FIRST ISSUED:
12-17-25

CAD SPECIALIST
NEG

CHECKED BY:
XXX

DESCRIPTION:
ENLARGED REFLECTED CEILING PLAN (PANEL LAYOUT)

FILE TYPE PROVIDED TO PROJECTWORKS:
PDF

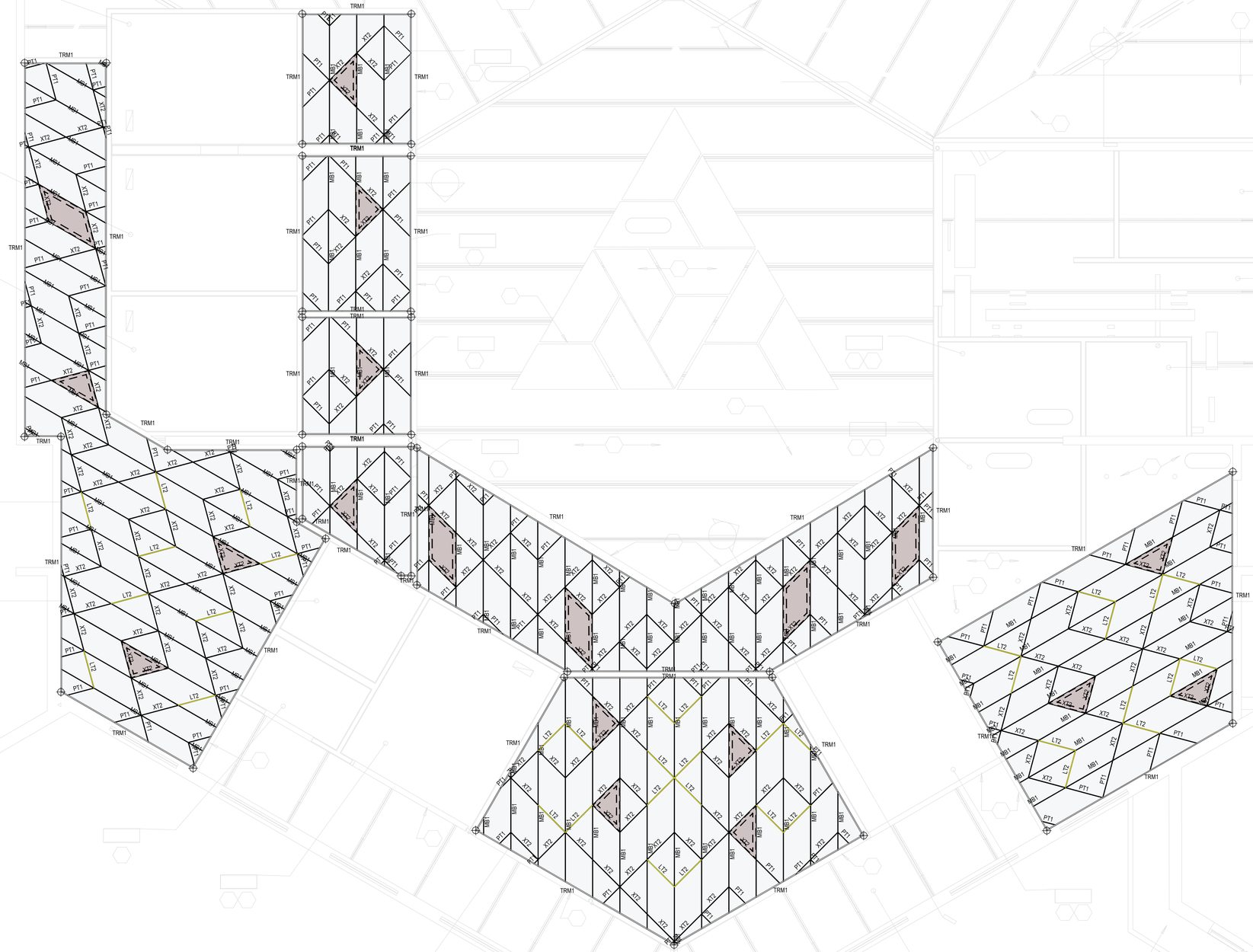
FIELD VERIFIED DIMENSIONS:
NO

REVISIONS

REV: 1	DATE: 12-19-25
REV: 2	DATE: XX-XX-XX
REV: 3	DATE: XX-XX-XX
REV: 4	DATE: XX-XX-XX

DRAWING NO.

R2



1 BANGOR BP4 - SUGGESTED SUSPENSION LAYOUT
SCALE: 1/4" = 1'-0"

Armstrong World Industries

ProjectWorks

PRE-CONSTRUCTION

JOHN GLENN HIGH SCHOOL - BAY CITY

PROJECTWORKS DRAWING PACKAGE

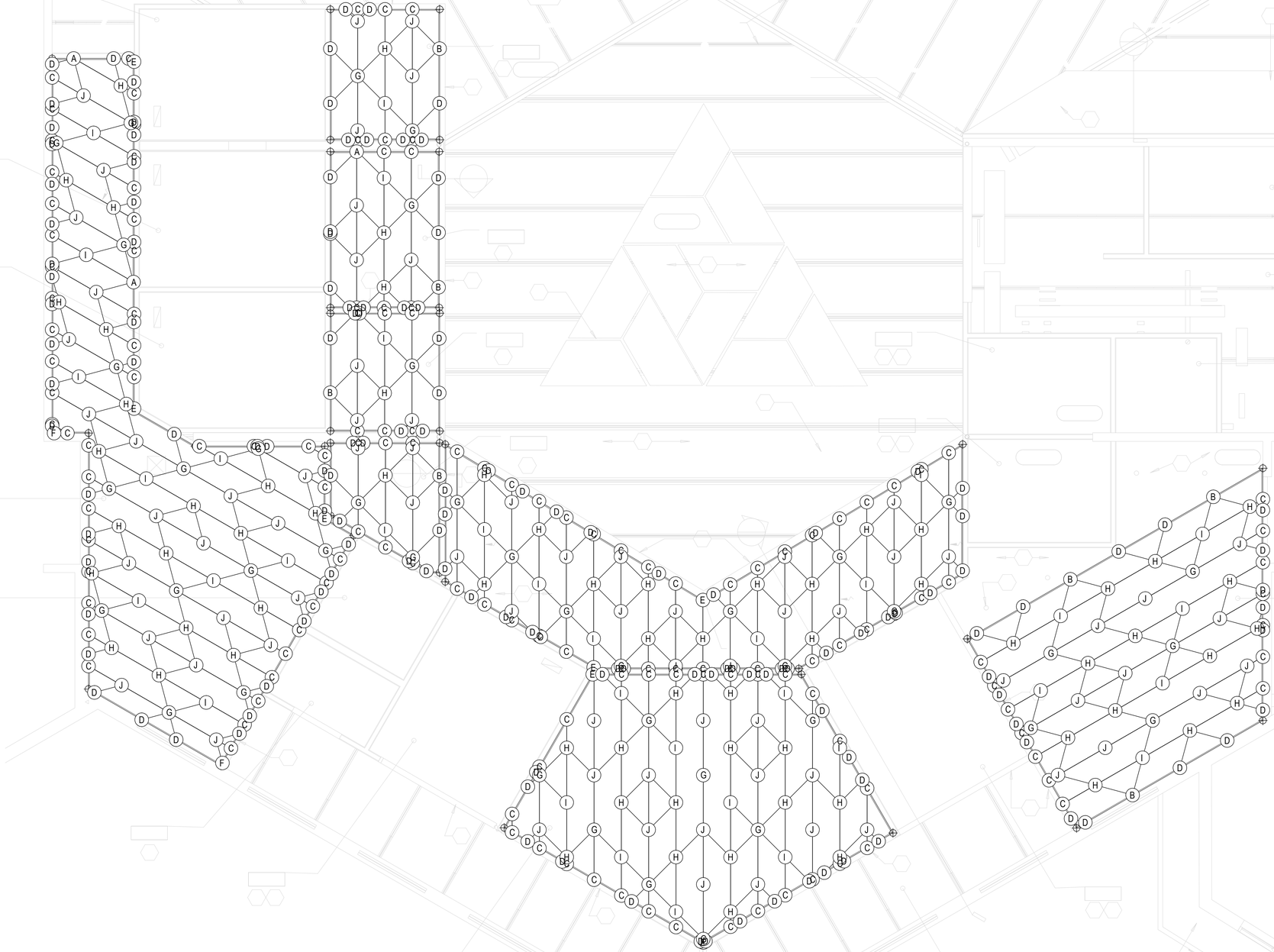
PROJECTWORKS NUMBER:	PW-02457312
CASE NUMBER:	02457959
DATE FIRST ISSUED:	12-17-25
CAD SPECIALIST	NEG
CHECKED BY:	XXX
DESCRIPTION:	SUGGESTED SUSPENSION LAYOUT
FILE TYPE PROVIDED TO PROJECTWORKS:	PDF
FIELD VERIFIED DIMENSIONS:	NO

REVISIONS

REV: 1	DATE: 12-19-25
REV: 2	DATE: XX-XX-XX
REV: 3	DATE: XX-XX-XX
REV: 4	DATE: XX-XX-XX

DRAWING NO.

S1



SUSPENSION HUB NOTE:
Quantities listed in Hub Schedule reflect quantities of components needed for each hub location.

1 BANGOR BP4 - SUSPENSION HUB LAYOUT
SCALE: 1/4" = 1'-0"

Armstrong World Industries

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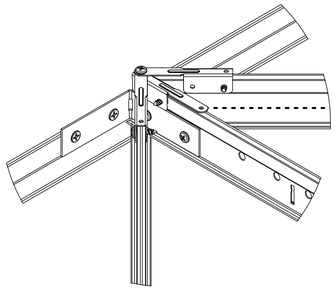
S2

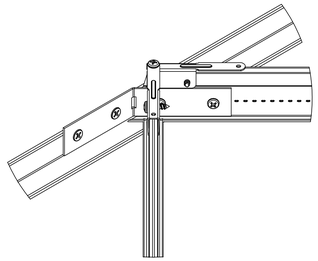
A



XTAC + PAC TO TWO ANGLE TEES AND MAIN BEAM

A HUB DETAIL A
SCALE: NTS

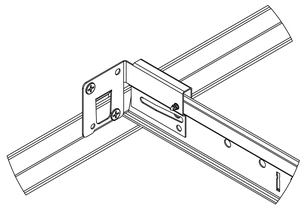
B



XTAC + PAC TO TWO ANGLE TEES

B HUB DETAIL B
SCALE: NTS

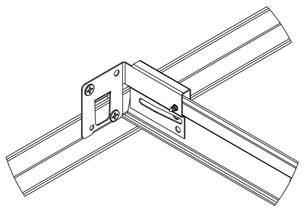
C



BERC2 TO MAIN BEAM

C HUB DETAIL C
SCALE: NTS

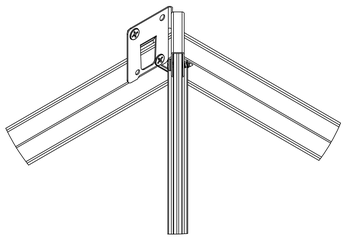
D



BERC2 TO CROSS TEE

D HUB DETAIL D
SCALE: NTS

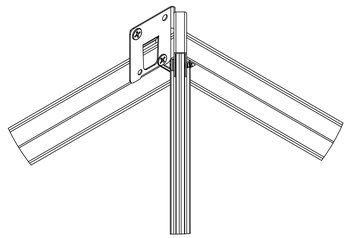
E



BERC2 TO ANGLE BEAM IN A CORNER

E HUB DETAIL E
SCALE: NTS

F



BERC2 TO ANGLE TEE IN A CORNER

F HUB DETAIL F
SCALE: NTS

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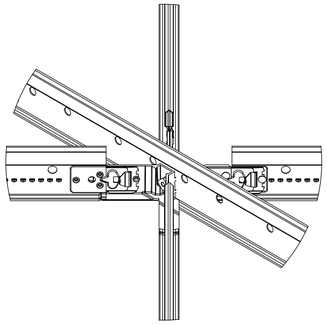
DRAWING NO.

D1

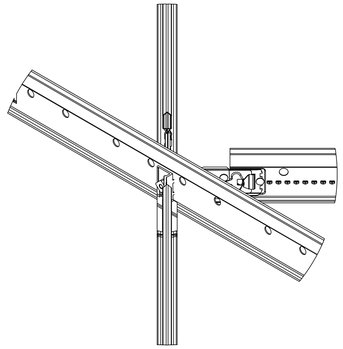
G



DOUBLE ANGLE BRACKET TO DOUBLE ANGLE BRACKET

G HUB DETAIL G
SCALE: NTS

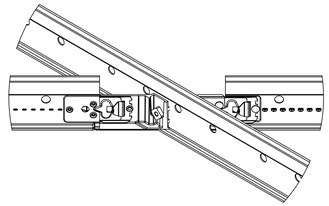
H



RIGHT ANGLE BRACKET TO DOUBLE ANGLE BRACKET

H HUB DETAIL H
SCALE: NTS

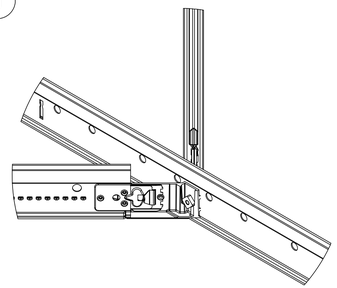
I



LEFT ANGLE BRACKET TO LEFT ANGLE BRACKET

I HUB DETAIL I
SCALE: NTS

J



LEFT ANGLE BRACKET TO RIGHT ANGLE BRACKET

J HUB DETAIL J
SCALE: NTS

E HUB DETAIL E
Scale: NTS

F HUB DETAIL F
Scale: NTS

Armstrong World Industries

ProjectWorks

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DRAWING NO.

D2

TABLE 1705.2
REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD	IBC REFERENCED
1. MATERIAL VERIFICATION OF STRUCTURAL STEEL	-	X		
2. INSPECTION TASKS FOR STRUCTURAL STEEL WELDING:				
a. PRIOR TO WELDING (OBSERVE, OR PERFORM FOR EACH WELDED JOINT OR MEMBER, THE QA TASKS LISTED IN AISC 360 TABLE N5.4-1)	SEE REFERENCED TABLE	SEE REFERENCED TABLE	AISC 360, SECTION N5.4 TABLE N5.4-1, AISC N5.4	
b. DURING WELDING (OBSERVE, OR PERFORM FOR EACH WELDED JOINT OR MEMBER, THE QA TASKS LISTED IN AISC 360 N5.4-2)	SEE REFERENCED TABLE	SEE REFERENCED TABLE	AISC 360, SECTION N5.4 TABLE N5.4-2, AISC N5.4	
c. AFTER WELDING (OBSERVE, OR PERFORM FOR EACH WELDED JOINT OR MEMBER, THE QA TASKS LISTED IN AISC 360 N5.4-3)	SEE REFERENCED TABLE	SEE REFERENCED TABLE	AISC 360, SECTION N5.4 TABLE N5.4-3, AISC N5.4	
d. NONDESTRUCTIVE TESTING (NDT) OF WELDED JOINTS:				
1) COMPLETE PENETRATION GROOVE WELDS 5/16" OR GREATER IN RISK CATEGORY III OR IV	-	X	AISC 360, SECTION N5.5, AISC N5.5	
2) COMPLETE PENETRATION GROOVE WELDS 5/16" OR GREATER IN RISK CATEGORY II	-	X		
3) THERMALLY CUT SURFACES OF ACCESS HOLES WHEN MATERIAL T>2"	-	X		
4) WELDED JOINTS SUBJECTED TO FATIGUE WHEN REQUIRED BY AISC 360, APPENDIX 3, TABLE A-3.1	-	X	AISC 360, APPENDIX 3	
5) MANUFACTURERS NDT REPORTS WHEN PERFORMED	-	X		
2. INSPECTION TASKS FOR STRUCTURAL STEEL BOLTING:				
a. PRIOR TO BOLTING (OBSERVE, OR PERFORM TASKS FOR EACH BOLTED CONNECTION, IN ACCORDANCE WITH QA TASKS LISTED IN AISC 360, N5.6-1)	SEE REFERENCED TABLE	SEE REFERENCED TABLE	AISC 360, SECTION N5.6 TABLE N5.6-2, AISC N5.6	
b. DURING BOLTING (OBSERVE THE QA TASKS LISTED IN AISC 360, TABLE N5.6-2)	SEE REFERENCED TABLE	SEE REFERENCED TABLE	AISC 360, SECTION N5.6 TABLE N5.6-2, AISC N5.6	
1) PRETENSIONED AND SLIP-CRITICAL JOINTS USING TURN-OF-NUT WITH MATCH MARKING, TWIST-OFF BOLT OR DIRECT TENSION INDICATOR METHODS OF INSTALLATION.	-	X	AISC 360, SECTION M2.5	
2) PRETENSIONED AND SLIP-CRITICAL JOINTS USING TURN-OF-NUT WITHOUT MATCHMARKING OR CALIBRATED WRENCH METHODS OF INSTALLATION.	X	-		
3) SNUG TIGHT JOINTS.	-	X		
c. AFTER BOLTING (PERFORM TASKS FOR EACH BOLTED CONNECTION IN ACCORDANCE WITH QA TASKS LISTED IN AISC 360, TABLE N5.6-3)	SEE REFERENCED TABLE	SEE REFERENCED TABLE	AISC 360, SECTION N5.6 TABLE N5.6-3, AISC N5.6	
3. REINFORCING STEEL:				
a. VERIFICATION OF WELDABILITY OF REINFORCING STEEL OTHER THAN ASTM A 706.	-	X		
2) REINFORCING STEEL RESISTING FLEXURAL AND AXIAL FORCES IN INTERMEDIATE AND SPECIAL MOMENT FRAMES, AND BOUNDARY ELEMENTS OF SPECIAL STRUCTURAL WALLS OF CONCRETE AND SHEAR REINFORCMENT.	X	-		
3) SHEAR REINFORCEMENT.	X	-		
4) OTHER REINFORCING STEEL.	-	X		
4. INSPECTION OF STEEL FRAME JOINT DETAILS FOR COMPLIANCE:				
a. DETAILS SUCH AS BRACING AND STIFFENING.	-	X		
b. MEMBER LOCATIONS.	X	-		
c. APPLICATION OF JOINT DETAILS AT EACH CONNECTION.	-	X		
5. MATERIAL VERIFICATION OF COLD-FORMED STEEL DECK:				
a. IDENTIFICATION MARKINGS	-	X		
b. MANUFACTURERS CERTIFIED TEST REPORTS	-	X		
6. CONNECTION OF COLD-FORMED DECK TO SUPPORTING STRUCTURE:				
a. WELDING	-	X		
b. OTHER FASTENERS				
1) VERIFY FASTENERS ARE IN CONFORMANCE WITH APPROVED SUBMITTAL	-	X	AISC 360, SECTION N6	
2) VERIFY FASTENER INSTALLATION IS IN CONFORMANCE WITH APPROVED SUBMITTAL AND MANUFACTURER'S RECOMMENDATIONS	-	X		

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BRIGHTON, MI 48116
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INTEGRATED DESIGNS, INC.
ARCHITECTURE
ENGINEERING
CONSULTING

BANGOR TOWNSHIP SCHOOL DISTRICT
BP4: JOHN GLENN HIGH SCHOOL RENOVATIONS
3201 KIESEL ROAD, BAY CITY, MI 48706
PROJECT NO. 22-011

NO.	REVISIONS	DATE	BY
1	ADDENDUM #2	01/15/26	

DESIGNED
DRAWN
CHECKED
APPROVED

STRUCTURAL TESTING

S0.0

PACKAGED COMMERCIAL ROOFTOP UNIT SCHEDULE - (DX - GAS)

UNIT ID	TOTAL SUPPLY (CFM)	MINIMUM OA (CFM)	AIRFLOW POSITION		SUPPLY FAN			DX COOLING COIL		AIR					NATURAL GAS HEATING SECTION							POWER EXHAUST OR BAROMETRIC RELIEF	FILTER TYPE	ELECTRICAL				DISCONNECT			CURB HEIGHT (IN)	UNIT WEIGHT (LBS)	MANUFACTURER / MODEL NO.
			SUPPLY	RETURN	ESP (IN WG)	FAN TYPE	DRIVE TYPE	TOTAL CAPACITY (MBH)	SENSIBLE CAPACITY (MBH)	EDB (°F)	EWB (°F)	LDB (°F)	LWB (°F)	REFRIGERANT TYPE	INPUT (MBH)	OUTPUT (MBH)	GAS PRESS. MIN.-MAX. (IN WG)	STAGES OR MODULATION TURNDOWN	BURNER TYPE	EAT (°F)	LAT (°F)			MOCP	MCA	VOLTS	PHASE	FURN. BY	INST. BY	TYPE			
RTU-1	1300	155	SIDE	SIDE	1.25	PLENUM	DIRECT	32.1	28.9	72.4	60	53	51.5	R-454B	80	64.8	4.5-14	2-STAGE	INDIRECT	61.6	106.6	BAROMETRIC RELIEF	2" MERV 8	30	23.0	208-230	3	MANUF.	MANUF.	NON-FUSED SWITCH	14	991	TRANE YZ036
RTU-2	2400	710	SIDE	SIDE	1.25	PLENUM	DIRECT	68.3	58.3	76	63	55	53.8	R-454B	150	121.5	4.5-14	2-STAGE	INDIRECT	49	95	BAROMETRIC RELIEF	2" MERV 8	60	42.0	208-230	3	MANUF.	MANUF.	NON-FUSED SWITCH	14	1012	TRANE YZK072
RTU-3	2400	710	SIDE	SIDE	1.25	PLENUM	DIRECT	68.3	58.3	76	63	55	53.8	R-454B	150	121.5	4.5-14	2-STAGE	INDIRECT	49	95	BAROMETRIC RELIEF	2" MERV 8	60	42.0	208-230	3	MANUF.	MANUF.	NON-FUSED SWITCH	14	1012	TRANE YZK072
RTU-4	1340	275	SIDE	SIDE	1.25	PLENUM	DIRECT	42.6	27.6	74	62	50.6	48.9	R-454B	80	64.8	4.5-14	2-STAGE	INDIRECT	0	0	BAROMETRIC RELIEF	2" MERV 8	50	35.0	208-230	1	MANUF.	MANUF.	NON-FUSED SWITCH	14	996	TRANE YZK048

NOTES:
1. DUAL INPUT ENTHALPY CONTROL ECONOMIZER.
2. DDC READY FOR TEMPERATURE CONTROLS CONTRACTOR PROVIDED AND FIELD MOUNTED CONTROLS.

HEATING HOT WATER COIL SCHEDULE

UNIT ID	SYSTEM SERVED	MIN NO. OF ROWS	CAPACITY (MBH)	AIR				FACE AREA (SQ FT)	WATER				CONTROL VALVE CONFIGURATION	MANUFACTURER / MODEL NO.
				FLOW (CFM)	EAT (°F)	LAT (°F)	APD (IN WG)		FLOW (GPM)	EWT (°F)	LWT (°F)	WPD (FT HD)		
HC-1	ERV-1	1	29.1	800	45	78.6	0.13	1.25	3	180	160	1.60	2-WAY	TRANE DT0B15012

VAV TERMINAL UNIT SCHEDULE WITH TEMPERING COIL - (HHW)

UNIT ID	AIRFLOW RANGE		INLET SP (IN WG)	DUCT CONNECTIONS		MAX. NC LEVEL	HEATING HOT WATER COIL									DISCONNECT			MANUFACTURER / MODEL NO.
	MIN. (CFM)	MAX. (CFM)		INLET SIZE (IN)	OUTLET SIZE (IN)		HTG (FTH)	APD @ COOLING CFM (IN WG)	EAT (°F)	LAT (°F)	TOTAL CAPACITY (MBH)	EWT (°F)	LWT (°F)	FLOW (GPM)	ROWS	DESIGN WPD (IN WG)	FURN. BY	INST. BY	TYPE	
VAV-1	75	300	0.00	6	10 x 8.25	35	230	0.17	55	95.8	10.2	180	160	1.0	1	1.70	MANUF.	MANUF.	TOGGLE	TRANE VCWF-06
VAV-2	685	800	0.00	10	14 x 12.125	35	685	0.15	55	88.7	25.0	180	148	1.6	1	6.70	MANUF.	MANUF.	TOGGLE	TRANE VCWF-10
VAV-3	50	200	0.00	5	10 x 8.25	35	150	0.06	55	104.2	8.0	180	160	0.8	1	1.12	MANUF.	MANUF.	TOGGLE	TRANE VCWF-05
VAV-4	117	340	0.00	6	10 x 8.25	35	230	0.21	55	95.8	10.2	180	160	1.0	1	1.71	MANUF.	MANUF.	TOGGLE	TRANE VCWF-06
VAV-5	40	100	0.00	5	10x8.25	35	40	0.02	55	145.7	4.0	180	165	0.5	1	0.50	MANUF.	MANUF.	TOGGLE	TRANE VCWF-05
VAV-6	550	600	0.00	10	14 x 12.125	35	550	0.09	55	95.4	24.1	180	160	2.4	1	14.30	MANUF.	MANUF.	TOGGLE	TRANE VCWF-10
VAV-7	40	200	0.00	5	10x8.25	35	138	0.06	55	102.2	7.0	180	152	0.5	1	0.50	MANUF.	MANUF.	TOGGLE	TRANE VCWF-05

NOTES:
1. AIRFLOW SHALL BE SET TO THE CFM INDICATED ON FLOOR PLANS.
2. MAXIMUM NC LEVEL BASED ON 3" PRESSURE DROP WITH NO ALLOWANCE FOR EXTERNAL ATTENUATION. MAXIMUM NC LEVEL SHALL NOT EXCEED 35.

PACKAGED, INDIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP-AIR UNIT SCHEDULE

UNIT ID	SERVICE	ASSOCIATED EXHAUST FAN	AIRFLOW (CFM)	SUPPLY FAN					NATURAL GAS HEATING SECTION							ELECTRICAL				DISCONNECT			CURB HEIGHT (IN)	MANUFACTURER / MODEL NO.
				ESP (IN WG)	FAN TYPE	DRIVE TYPE	BHP	HP	INPUT (MBH)	OUTPUT (MBH)	GAS PRESS MIN.-MAX. (IN WG)	STAGES OR MODULATION TURNDOWN	BURNER TYPE	EAT (°F)	LAT (°F)	FILTER TYPE	MOP	MCA	VOLTS	PHASE	FURN. BY	INST. BY	TYPE		
MAU-1	A7 CHEMISTRY FUME HOOD MAKEUP	EF-1	800	0.30	FC DWDI	DIRECT	0.31	1	120	96	3.5-14	ELECTRONIC MODULATING	INDIRECT	45	70	2" MERV 8	15	6.0	208	3	MANUF.	MANUF.	NON-FUSED SWITCH	14	NAGAS LD(E)-120
MAU-2	D1 ART SPRAYPAINT BOOTH MAKEUP	SPRAY BOOTH	600	0.30	FC DWDI	DIRECT	0.31	1	120	96	3.5-14	ELECTRONIC MODULATING	INDIRECT	45	70	2" MERV 8	15	6.0	208	3	MANUF.	MANUF.	NON-FUSED SWITCH	14	NAGAS LD(E)-120

NOTES:
1. INTERLOCK MAKEUP-AIR UNIT WITH ASSOCIATED EXHAUST FAN.
2. FURNISH WITH FULLY INSULATED CURB.
3. DDC READY FOR TEMPERATURE CONTROLS CONTRACTOR PROVIDED AND FIELD MOUNTED CONTROLS.

PACKAGED, OUTDOOR, FIXED PLATE ENERGY RECOVERY UNIT SCHEDULE

UNIT ID	AREA SERVED	SUPPLY FAN				EXHAUST FAN				PERFORMANCE										FILTER TYPE	ELECTRICAL				DISCONNECT			CURB HEIGHT (IN)	WEIGHT (LBS)	MANUFACTURER / MODEL NO.
										SUMMER					WINTER																
										OUTSIDE AIR				EXHAUST AIR		OUTSIDE AIR		EXHAUST													
		ESP (IN WG)	AIR FLOW (CFM)	FAN TYPE	DRIVE TYPE	ESP (IN WG)	AIR FLOW (CFM)	FAN TYPE	DRIVE TYPE	EDB (°F)	EWB (°F)	LDB (°F)	LWB (°F)	EDB (°F)	RH%	EDB (°F)	LDB (°F)	EDB (°F)			MOCP	MCA	VOLTS	PHASE	FURN. BY	INST. BY	TYPE			
ERV-1	A7 CHEMISTRY C006	0.5	800	PLENUM	DIRECT	0.5	800	PLENUM	DIRECT	90.7	73.4	79.0	67.4	75.0		-10.0	49.7	70.0		2" MERV 8	20	15.1	120	1	MANUF.	MANUF.	NON-FUSED SWITCH	14	430	RENEWAIRE HE1.5RTH

NOTES:
1. HEAT AND HUMIDITY TRANSFER
2. PROVIDE WITH MOTORIZED DAMPERS ON BOTH AIRSTREAMS.
3. TERMINAL STRIP UNIT CONTROL FOR EC MOTORS.
4. BACNET INTEGRATION CAPABILITY.

FAN COIL UNIT SCHEDULE

UNIT ID	SERVICE	ORIENTATION	NOMINAL AIRFLOW (CFM)	ESP (IN WG)	COOLING COIL		AIR				WATER				HEATING COIL	AIR		WATER			UNIT DIMENSIONS			FILTER TYPE	ELECTRICAL				DISCONNECT			MANUFACTURER / MODEL NO.
					TOTAL CAPACITY (MBH)	SENSIBLE CAPACITY (MBH)	EDB (°F)	EWB (°F)	LDB (°F)	LWB (°F)	FLOW (GPM)	EWT (°F)	LWT (°F)	WPD (FT HD)	MIN. TOTAL CAPACITY (MBH)	EAT (°F)	LAT (°F)	FLOW (GPM)	EWT (°F)	LWT (°F)	WPD (FT HD)	LENGTH (IN)	DEPTH (IN)	HEIGHT (IN)		MOCP	MCA	VOLTS	PHASE	FURN. BY	INST. BY	TYPE	
FCU-1	AQUAPONIC LAB C014	CEILING SUSPENDED	400	0.40	13.1	9.7	80	67	57.8	56.5	2.6	45	55	10.20	12.8	55	84.5	1.3	180	160	0.33	38.0	26.0	10.0	1" MERV 8	15	2.75	115	1	MANUF.	MANUF.	NON-FUSED SWITCH	TRANE FCCB040

NOTES:
1. PROVIDED BY MANUFACTURER:
   A. DUCTED SUPPLY FRONT, MIXED AIR BACK.
   B. AUXILIARY DRAIN PAN.
   C. ECM FAN.
   D. BACNET CAPABILITY.
   E. WALL MOUNTED THERMOSTAT WITH HUMIDITY SENSOR.
2. PROVIDED BY MECHANICAL CONTRACTOR:
   A. FIELD FABRICATED MIXING BOX.
   B. 2-WAY CONTROL VALVES.
      a. CONTROL VALVES SHALL BE SELECTED FOR A PRESSURE DROP EQUAL TO TWO TIMES THE PRESSURE DROP OF THE ASSOCIATED HEAT TRANSFER DEVICE.
      b. PRESSURE DROP OF THE SELECTED VALVE SHALL NOT EXCEED A MAXIMUM OF 15 FEET OF HEAD OR A MINIMUM OF 2.3 FEET OF HEAD.

INTAKE/RELIEF HOOD SCHEDULE

UNIT ID	SYSTEM SERVED	AIRFLOW (CFM)	THROAT SIZE (IN)	THROAT VELOCITY (FPM)	STATIC PRESSURE DROP (IN WG)	OVERALL WIDTH (IN)	OVERALL LENGTH (IN)	OVERALL HEIGHT (IN)	CURB CAP WIDTH (IN)	CURB CAP LENGTH (IN)	ROOF OPENING WIDTH (IN)	ROOF OPENING LENGTH (IN)	CURB HEIGHT (IN)	HOOD CONSTRUCTION	MANUFACTURER / MODEL NO.
GV-1	FCU-1	100	8	270	0.01	20.5	20.5	19	19	19	10.5	10.5	24	ALUMINUM	GREENHECK GRSR-8

EXHAUST FAN SCHEDULE

UNIT ID	SERVING	ASSOCIATED MAKEUP-AIR UNIT	TYPE	AIRFLOW (CFM)	ESP (IN WG)	FAN (RPM)	MOTOR			ELECTRICAL					DISCONNECT				CURB HEIGHT (IN)	MANUFACTURER / MODEL NO.
							BHP	HP	DRIVE TYPE	FLA	MCA	MOP	VOLTS	PHASE	FURN. BY	INST. BY	TYPE			
EF-1	A7 CHEMISTRY FUME HOOD	MAU-1	HIGH PLUME, UTILITY SET	800	0.40	2467	0.53	3/4	BELT	7.6	9.5	15	208	1	MANUF.	MANUF.	NON-FUSED SWITCH		14	GREENHECK VK-H-10-6
EF-2	TOILET B102	N/A	CEILING	75	0.30	950	0.01	-	DIRECT	0.19	.20	15	115	1	MANUF.	MANUF.	NON-FUSED SWITCH		0	GREENHECK SP-A110

NOTES:
1. EF-1 SHALL BE SUPPLIED/INSTALLED WITH THE FOLLOWING:
   A. AMCA CLASS 'B' SPARK-PROOF CONSTRUCTION.
   B. BYPASS PLENUM.
   C. VARIABLE SPEED DRIVE.
   D. INTERLOCKED WITH MAU-1 OPERATION.
   E. HIGH PLUME DISCHARGE NOZZLE
2. EF-2 SHALL OPERATE VIA LIGHT SWITCH.
3. PROVIDE ALL FANS WITH GRAVITY BACKDRAFT DAMPERS.

MINI-SPLIT OUTDOOR UNIT SCHEDULE

UNIT ID	ASSOCIATED INDOOR UNIT ID	COOLING			COMPRESSOR		REFRIGERANT			ELECTRICAL					DISCONNECT			MANUFACTURER / MODEL NO.
		NOMINAL TONNAGE	LOW AMBIENT (°F)	DESIGN AMBIENT (°F)	NO.	TYPE	TYPE	LIQUID (IN)	SUCTION (IN)	RECOMMENDED BREAKER	MOCP	MCA	VOLTS	PHASE	FURN. BY	INST. BY	TYPE	
ACCU-1	AC-1	1.5	-40	95	1	INVERTER DRIVEN	R454B	1/4	1/2	20	27	16.0	208	1	ELEC.	ELEC.	NON-FUSED SWITCH	MITSUBISHI PUY-AK18NL
ACCU-2	AC-2	1.5	-40	95	1	INVERTER DRIVEN	R454B	1/4	1/2	20	27	16.0	208	1	ELEC.	ELEC.	NON-FUSED SWITCH	MITSUBISHI PUY-AK18NL

NOTES:
*INDOOR UNIT IS POWERED BY OUTDOOR UNIT.
1. FURNISH WITH:
   A. 18" HIGH STAND.
   B. LOW AMBIENT KIT AND WIND BAFFLE PROVIDING 100% COOLING DOWN TO 0°F.

MINI-SPLIT INDOOR UNIT SCHEDULE

UNIT ID	UNIT TYPE	ASSOCIATED OUTDOOR UNIT ID	AREA SERVED	AIRFLOW (CFM)	TOTAL CAPACITY (MBH)	SENSIBLE CAPACITY (MBH)	DIMENSIONS			REFRIGERANT			ELECTRICAL				DISCONNECT				MANUFACTURER / MODEL NO.
							LENGTH (IN)	WIDTH (IN)	HEIGHT (IN)	TYPE	LIQUID (IN)	SUCTION (IN)	MOCP	VOLTS	PHASE	FURN. BY	INST. BY.	TYPE			
AC-1	WALL	ACCU-1	SERVER	450	17.1	10.8	35 11/32	9 11/32	11 25/32	R454B	1/4	1/2	*	208	1	MANUF.	ELEC.	NON-FUSED SWITCH	MITSUBISHI PKA-AL18NL		
AC-2	WALL	ACCU-2	SERVER	450	17.1	10.8	35 11/32	9 11/32	11 25/32	R454B	1/4	1/2	*	208	1	MANUF.	ELEC.	NON-FUSED SWITCH	MITSUBISHI PKA-AL18NL		

NOTES:
*INDOOR UNIT IS POWERED BY OUTDOOR UNIT.
1. FURNISH WITH:
   A. WALL MOUNT CONDENSATE PUMP, BLUE DIAMOND MINIBLUE PUMP WITH RESERVOIR SENSOR, 2.1 G/HR, 23 FT HEAD, 16.5 FT LIFT, 0.5 A, 110V #X87-721.
   B. WALL MOUNTED THERMOSTAT.

GRILLE, REGISTER AND DIFFUSER SCHEDULE

UNIT ID	SERVICE	FACE SIZE	NECK SIZE	MOUNTING	FINISH	MATERIAL	TYPE	MODEL NO.	REMARKS
A	SUPPLY	24"x24"	SEE PLANS	NOTE 2	WHITE	STEEL	SQUARE CONE	SCDA	ADJUSTABLE
B	SUPPLY	12"x12"	SEE PLANS	NOTE 2	WHITE	STEEL	SQUARE CONE	SCDA	ADJUSTABLE
C	SUPPLY	NECK=2"	SEE PLANS	DUCT	PAINTABLE	STEEL	LOUVERED	520	ADJUSTABLE, DOUBLE DEFLECTION
D	SUPPLY	24"x48"	SEE PLANS	NOTE 2	WHITE	STEEL	SHAPE (TRAINGLE)	SHP-CF-TRI	ARMSTRONG DESIGNFLEX CEILING INTEGRATION
E	SUPPLY	24"x12"	18"x6"	NOTE 2	WHITE	STEEL	PERFORATED	PDDR	
F	RETURN	24"x48"	SEE PLANS	NOTE 2	WHITE	STEEL	SHAPE (TRIANGLE)	SHP-PR-TRI	ARMSTRONG DESIGNFLEX CEILING INTEGRATION
G	RETURN	24"x48"	SEE PLANS	NOTE 2	WHITE	STEEL	SHAPE (PARALLELOGRAM)	SHP-PR-PRL-R	ARMSTRONG DESIGNFLEX CEILING INTEGRATION
H	RETURN	24"x48"	SEE PLANS	NOTE 2	WHITE	STEEL	SHAPE (PARALLELOGRAM)	SHP-PR-PRL-L	ARMSTRONG DESIGNFLEX CEILING INTEGRATION
J	EXHAUST	8"x8"	8"x8"	NOTE 2	WHITE	STEEL	LATTICE GRILLE	LG	1" MESH
K	RETURN	12"x12"	6"x6"	NOTE 2	WHITE	STEEL	PERFORATED	PDDR	
L	RETURN	6"x6"	6"x6"	WALL	PAINTABLE	ALUMINUM	LOUVERED	610Z	0° DELFECTION
M	EXHAUST	24"x24"	SEE PLANS	NOTE 2	WHITE	STEEL	PERFORATED	PDDR	
N	SUPPLY	-	SEE PLANS	WALL	-	ALUMINUM	LINEAR BAR GRILLE	LBP	15A - 1/4" BLADE SPACING, 0° DEFLECTION, WITH BLADE TYPE DAMPER, DIRECTIONAL VANES, PENCIL PROOF.

NOTES:
1. MODEL NUMBERS ARE PRICE UNLESS OTHERWISE NOTED.
2. REFER TO ARCHITECTURAL CEILING PLAN AND COORDINATE FRAME TYPE ACCORDINGLY.

FINNED-TUBE RADIATION HEATER (HOT WATER) SCHEDULE

UNIT ID	AREA SERVED	ENCLOSURE					MANUFACTURER / MODEL NO.
		TYPE	COLOR	HEIGHT (IN)	DEPTH (IN)	LENGTH (IN)	
FTR-1	G TLT A005	ARCHITECTURAL, SLOPED TOP	VULCAN P-1	14	5 1/16	14'-8"	VULCAN JV4-ARS
FTR-2	G TLT C002	ARCHITECTURAL, SLOPED TOP	VULCAN P-1	14	5 1/16	14'-5"	VULCAN JV4-ARS
FTR-3	TLT C001	ARCHITECTURAL, SLOPED TOP	VULCAN P-1	14	5 1/16	3'-4"	VULCAN JV4-ARS
FTR-4	TOILET D010	ARCHITECTURAL, SLOPED TOP	VULCAN P-1	14	5 1/16	14'-8"	VULCAN JV4-ARS

NOTES:
* CONTRACTOR SHALL FIELD-MEASURE FOR EXACT LENGTH. COORDINATE DIMENSIONS WITH SUPPLIED UNIT VENTILATOR.
1. ELEMENT SHALL BE COPPER PIPING AND ALUMINUM FINNED.
2. PROVIDE WALL TO WALL ENCLOSURE UNLESS OTHERWISE NOTED.
3. PROVIDE WALL SLEEVES, WALL SLEEVE SUPPORTS, BACKPLATES, BRACKETS, AND END CAPS TO CONCEAL PIPING, VALVES, AND FITTINGS AS NEEDED.
4. FURNISH WITH THERMOSTATIC RADIATOR VALVE, DANFOSS OR EQUIVALENT, WITH ACCESS PANEL IN ENCLOSURE.

D1 ARCHITECTURE ENGINEERING CONSULTING
INTEGRATED DESIGNS, INC.
MARQUETTE OFFICE:
1021 W. BARAGA AVENUE
MARQUETTE, MI 49855
PHONE: 9065228480 FAX: 9065228524
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BANGOR TOWNSHIP SCHOOL DISTRICT
PHASE 4 - HIGH SCHOOL RENOVATIONS
3201 KIESEL RD. BAY CITY, MI 48706
PROJECT NO. 22-011

NO.	REVISIONS	DATE
A	DESIGN DEVELOPMENT	07.07.25
B	95% OWNER REVIEW	10.01.25
0	FOR CONSTRUCTION	11.14.25
1	ADDENDUM #1	01.08.26

BY	
DESIGNED	CRP
DRAWN	CRP
CHECKED	SLB
APPROVED	SLB

MECHANICAL SCHEDULES

M4.0

SEQUENCE OF OPERATION:

A. THERMOSTAT SETPOINT ADJUSTMENT LIMITATION

1. BUILDING AUTOMATION SYSTEM (BAS) SHALL INCLUDE THE ABILITY TO LIMIT THE RANGE OCCUPANTS CAN ADJUST SETPOINTS FROM ANY OF THE THERMOSTATS.

B. PACKAGED GAS HEATING ELECTRIC COOLING ROOFTOP UNITS (RTU)

1. PACKAGED ROOFTOP UNITS SHALL BE FACTORY FURNISHED WITH ELECTROMECHANICAL CONTROLS. CONTROLS CONTRACTOR SHALL FIELD INSTALL A CONTROLLER ON THE PACKAGED ROOFTOP UNIT THAT INTEGRATES WITH THE BAS TO PROVIDE THE CONTROL SEQUENCE FUNCTIONS DESCRIBED.
2. BAS SYSTEM SHALL PROVIDE SPACE TEMPERATURE SET-POINT CONTROL FOR ROOFTOP UNITS.
3. THE BAS SYSTEM CONTROLLER SHALL SEND THE RTU CONTROLLER START/STOP INITIATION, OCCUPIED/UNOCCUPIED TIME SCHEDULING FUNCTIONS, MORNING WARM-UP/PRECOOL, AND HEATING/COOLING MODES.
4. DURING UNOCCUPIED MODE, THE RTU SHALL SHUT-OFF. IF THE ZONE TEMPERATURE DRIFTS TO THE UNOCCUPIED HEATING OR COOLING SETPOINT, THE RTU SHALL START AND PROVIDE THE NECESSARY HEATING OR COOLING TO SATISFY THE ZONE TEMPERATURE. THE OUTSIDE AIR DAMPER SHALL REMAIN CLOSED UNLESS ECONOMIZING.
5. THE SYSTEM CONTROLLER SHALL AUTOMATICALLY DETERMINE THE OPTIMUM START TIME SO THAT EACH ZONE REACHS ITS OCCUPIED SETPOINT IN TIME FOR THE SCHEDULED OCCUPANCY.
6. FOR THOSE ZONES EQUIPPED WITH AN OCCUPANCY SENSOR OR WITH A CO2 SENSOR, OUTDOOR AIRFLOW SHALL BE RESET BASED ON OCCUPANCY STATUS AND OR MEASURED CO2 CONCENTRATION.
7. OUTSIDE AIR QUANTITY FOR A UNIT SERVING A SINGLE ZONE SHALL BE DETERMINED BY A WALL MOUNTED CO2 SENSOR LOCATED WITHIN THE SPACE.
8. GAS BURNER STAGING/FIRING MODULATION, DAMPER POSITION/MODULATION, COOLING COMPRESSOR AND CONDENSER FAN SEQUENCING AS WELL AS ENERGY RECOVERY COMPONENT CONTROL SHALL BE PERFORMED BY THE FACTORY INSTALLED MICROPROCESSOR CONTROLS.
9. RTU FAN STATUS SHALL BE PROVEN THRU THE BAS AND AN ALARM SENT IF AT ANY TIME THE FAN STOPS OPERATING WHEN PROGRAMMED TO BE ON.

C. ROOFTOP UNIT, VARIABLE AIR VOLUME (RTU-1, RTU-4)

1. PACKAGED ROOFTOP UNITS SHALL BE FACTORY FURNISHED WITH ELECTROMECHANICAL CONTROLS. CONTROLS CONTRACTOR SHALL FIELD INSTALL A CONTROLLER ON THE PACKAGED ROOFTOP UNIT THAT INTEGRATES WITH THE BAS TO PROVIDE THE CONTROL SEQUENCE FUNCTIONS DESCRIBED.
2. WITH THE SUPPLY FAN VARIABLE SPEED DRIVE HAND/OFF/AUTO SWITCH IN THE "AUTO" POSITION, THE SUPPLY FAN SHALL BE AUTOMATICALLY STARTED AND STOPPED THROUGH THE BAS CONTROLS BASED ON THE OPTIMUM START PROGRAM AND THE OCCUPANCY SCHEDULE. THE UNIT FAN SHALL OPERATE CONTINUOUSLY DURING OCCUPIED PERIODS AND CYCLED BY THE BAS SYSTEM ON A CALL FOR HEAT DURING UNOCCUPIED PERIODS TO MAINTAIN A TEMPERATURE OF 65 F, AS SENSED BY ANY OF THE VARIABLE AIR VOLUME BOX SPACE SENSORS. IF THE SUPPLY FAN IS STARTED PRIOR TO THE OCCUPANCY SCHEDULE, THE OUTDOOR AIR DAMPER SHALL REMAIN CLOSED AND THE RETURN DAMPER SHALL BE OPEN IN A 100% RE-CIRCULATION MODE.
3. WHENEVER THE SUPPLY FAN IS ENERGIZED DURING THE OCCUPIED MODE, THE OUTSIDE AIR DAMPER SHALL OPEN TO ITS MINIMUM POSITION.
4. PROOF OF FLOW FOR THE SUPPLY FAN SHALL BE VERIFIED TO THE BAS SYSTEM BY THE FAN AIR FLOW CURRENT SENSOR.
5. THE BAS SYSTEM SHALL MODULATE THE SUPPLY FAN VARIABLE SPEED DRIVE VIA THE SUPPLY DUCT STATIC PRESSURE SENSOR(S) TO MAINTAIN A MINIMUM STATIC PRESSURE IN THE SUPPLY DUCT TO INSURE PROPER TERMINAL BOX OPERATION. THE SUPPLY DUCT STATIC PRESSURE SHALL BE FIELD SET TO MAINTAIN THE NECESSARY STATIC PRESSURE TO BALANCE OUT THE SYSTEM AT THE FARTHEST POINT IN THE DUCT PRIOR TO THE LAST THREE VAV BOXES WHEN THOSE BOXES ARE 95% OPEN. IF MULTIPLE SENSING LOCATIONS ARE SHOWN, THE BAS SHALL MAINTAIN THE STATIC PRESSURE SETPOINT AT THE LOWEST READING SENSOR.
6. STATIC PRESSURE RESET CONTROL SHALL RESET PRESSURE SETPOINT USING TRIM AND RESPOND LOGIC WITHIN 0.15 IN. W.C. TO 1.3 IN. W.C. WHEN THE FAN IS OFF, THE SETPOINT SHALL BE RESET TO 0.8 IN. W.C. (ADJ.) AND THIS SETPOINT SHALL BE USED ON THE SYSTEM START-UP. WHILE THE FAN IS PROVEN ON, EVERY TWO MINUTES, TRIM THE SET-POINT BY 0.04 IN. W.C. IF THERE ARE TWO OR FEWER ZONE PRESSURE REQUESTS. IF THERE ARE MORE THAN TWO ZONE PRESSURE REQUESTS, RESPOND BY INCREASING THE SETPOINT BY 0.06 IN. W.C. A ZONE PRESSURE REQUEST IS GENERATED WHEN A VAV DAMPER IS GREATER THAN 95% OPEN UNTIL IT DROPS TO 80% OPEN. PROVIDE A BINARY DATA ENABLE POINT FOR EACH ZONE TO ENABLE/DISABLE THE ZONE DAMPER IN THE TRIM AND RESPOND ALGORITHM. ALL SETPOINTS, TIMERS, AND ZONE PRESSURE REQUEST THRESHOLD FOR THE STATIC PRESSURE RESET SHALL BE ADJUSTABLE. TUNE THE RESET TO PREVENT CYCLIC INSTABILITY AFTER THE SPACE IS OCCUPIED. PROVIDE A TREND GRAPH TO SHOW THE RELATIVE STABILITY OF THE STATIC PRESSURE SETPOINT. FINAL MAXIMUM SETPOINT SHALL BE DETERMINED BY THE BALANCING CONTRACTOR TO SATISFY THE WORST-CASE ZONE AT MAXIMUM DESIGN CONDITION.
7. A DISCHARGE HIGH-LIMIT STATIC PRESSURE SENSOR LOCATED AT THE RTU SHALL OVERRIDE THE SUPPLY FAN SPEED THROUGH THE BAS SYSTEM TO PREVENT THE DISCHARGE STATIC PRESSURE FROM EXCEEDING ITS HIGH LIMIT.
8. THE DISCHARGE AIR TEMPERATURE SENSOR LOCATED IN THE SUPPLY AIR DUCT DOWNSTREAM OF THE RTU SHALL MODULATE THE HEATING COIL CONTROL VALVE, THE OUTSIDE, RETURN, AND EXHAUST AIR DAMPERS, AND COOLING COMPRESSOR AND CONDENSER VALVE IN SEQUENCE TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SET POINT.
9. WHEN THE SYSTEM IS IN THE HEATING MODE, THE OUTSIDE, RETURN, AND RELIEF AIR DAMPERS SHALL MODULATE IN SEQUENCE TO INTRODUCE THE MINIMUM OUTSIDE AIR. BAS SHALL STAGE THE GAS BURNER AS REQUIRED TO RAISE THE DISCHARGE AIR TEMPERATURE AND SATISFY THE SPACE TEMPERATURE SENSOR.
10. ON A CALL FOR COOLING, THE HEATING VALVE SHALL BE CLOSED, AND THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL MODULATE OPEN TO MAINTAIN THE DISCHARGE AIR SET-POINT IF THE ENTHALPY CONTROL DETERMINES THAT OUTSIDE TEMPERATURE AND HUMIDITY CAN PROVIDE ECONOMIZER COOLING. IF THE OUTSIDE AIR CONDITIONS CANNOT SATISFY THE DISCHARGE AIR REQUIREMENTS, THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL RETURN TO THEIR MINIMUM VENTILATION SETTINGS AND THE DX COOLING SHALL BE INITIATED ON.
11. IF THE LOW TEMPERATURE PROTECTION THERMOSTAT SENSES TEMPERATURE BELOW ITS SET POINT, IT WILL SHUT DOWN THE UNIT AND OPEN COIL VALVES FULLY. THE LOWER LIMIT THERMOSTAT MUST BE MANUALLY RESET.
12. A CARBON DIOXIDE SENSOR LOCATED EITHER IN THE MAIN RETURN AIR DUCT, OR IN A SPACE AS INDICATED ON THE DRAWING, SHALL OVER-RIDE THE DAMPER POSITION AND MODULATE OPEN THE OUTSIDE AIR DAMPER IF THE SENSOR LIMIT SE-POINT IS EXCEEDED. WHEN THE OUTSIDE AIR DAMPER IS MODULATED OPEN, THE RETURN AIR DAMPER SHALL MODULATE CLOSED AND THE EXHAUST AIR DAMPER SHALL OPEN PROPORTIONATELY.

D. VARIABLE AIR VOLUME TERMINALS WITH HOT WATER REHEAT COIL (VAV-1 THRU VAV-7)

1. THE VAV TERMINAL UNIT MINIMUM AND MAXIMUM AIR FLOW SHALL BE MAINTAINED AS INDICATED ON THE VARIABLE AIR VOLUME BOX SCHEDULE ON THE DRAWING.
2. AS THE SPACE TEMPERATURE FALLS BELOW THE SET-POINT (70 F ADJ) OF THE WALL MOUNTED THERMOSTAT, THE TERMINAL UNIT CONTROLLER SHALL KEEP THE SUPPLY FAN AIR FLOW AT MINIMUM SETTING AND SHALL MODULATE THE REHEAT CONTROL VALVE(S) TO MAINTAIN SPACE TEMPERATURE SET-POINT.
3. AS THE SPACE TEMPERATURE RISES ABOVE THE SET-POINT, THE TERMINAL UNIT CONTROLLER WILL KEEP REHEAT COIL AND PERIMETER RADIATION CONTROL VALVES CLOSED AND SHALL MODULATE THE SUPPLY AIR FLOW BETWEEN ITS MINIMUM AND MAXIMUM SETTING TO MAINTAIN SPACE TEMPERATURE. FULL COOLING SHALL BE AT THE SET-POINT PLUS 4 F DEAD-BAND (74 F ADJ).
4. DURING THE UNOCCUPIED MODE, THE VAV TERMINAL UNIT CONTROLLER SHALL SET BACK THE SPACE TEMPERATURE SET-POINT (FOR HEATING) 65 DEGREES F (ADJUSTABLE). AIR FLOW SETTING SHALL BE ALLOWED TO MODULATE BETWEEN MINIMUM AND MAXIMUM SETTINGS IN THE UNOCCUPIED MODE. DURING THE OCCUPIED PERIOD, THE VAV TERMINAL CONTROLLER SHALL SET THE SPACE TEMPERATURE SET-POINT FOR HEATING TO BETWEEN 70 AND 74 DEGREES F (MANUALLY ADJUSTABLE AT THE SPACE SENSOR THROUGH A RANGE OF 4 DEGREES F). THE ALLOWABLE TEMPERATURE RANGE SHALL BE ADJUSTABLE THROUGH THE DDC SYSTEM.
5. STATIC SET-POINT RESET:
   A. PROVIDE STATIC PRESSURE SET-POINT RESET BASED ON ZONE DEMAND AS REQUIRED BY ASHRAE STANDARD 90.1 FOR SYSTEMS WITH DDC CONTROL AT THE ZONE LEVEL. THE BASIC LOGIC BEHIND STATIC PRESSURE SET-POINT RESET IS SIMPLY TO ADJUST, IN A STABLE MANNER, THE STATIC PESSURE SET-POINT UNTIL ONE VAV ZONE DAMPER IS WIDE OPEN.
   B. USE "TRIM AND RESPOND" CONTROL LOOP LOGIC TO ADJUST STATIC PRESSURE SET-POINT. STATIC PRESSURE SET-POINT SHALL BE RESET USING TRIM AND RESPOND LOGIC WITHIN THE RANGE OF 0.15 IN. W.G. TO 1.3 IN. W.G. WHEN THE FAN IS OFF, THE SET-POINT SHALL BE 0.5 IN. W.G. WHILE THE FAN IS PROVEN ON, EVERY TWO MINUTES, TRIM THE SET-POINT BY 0.04 IN. W.G. RESPOND BY INCREASING THE SET-POINT BY 0.03 IN. W.G. TIMES THE NUMBER OF PRESSURE REQUESTS BUT NO MORE THAN 0.12 IN. W.G.
   C. CONTROLS MUST BE TUNED IN THE FIELD, AND TREND LOGS OF SYSTEM OPERATION USED TO VERIFY THAT THE LOGIC IS STABLE; AND THAT ROGUE ZONES ARE NOT LIMITING THE RESET RANGE.
   D. TREND LOG OF ACTUAL STATIC PRESSURE MEASURED NEAR THE END OF THE DUCT MAIN(S), STATIC PRESSURE SET-POINT, AND ZONE PRESSURE REQUESTS, SHALL BE USED TO DEMONSTRATE THAT THE RESET IS NOT TOO FAST.
6. DURING OCCUPIED PERIODS, THE BAS SHALL RESET ZONE MINIMUM AIRFLOW SETTING BASED ON CO2 INPUT LEVELS. WHEN CO2 INPUT LEVELS ARE AT OR BELOW 1000 PPM (ADJ.), THE ZONE AIR FLOW SHALL BE EQUAL TO THE MINIMUM VAV BOX AIRFLOW SETTING. WHEN CO2 INPUT LEVELS ARE AT 2000 PPM OR HIGHER (ADJ.), THE ZONE AIR FLOW SHALL BE EQUAL TO THE VAV BOX MAXIMUM AIRFLOW SETTING. WHEN THE ZONE CO2 LEVEL IS BETWEEN 1000 AND 2000 PPM, THE AIRFLOW SHALL VARY PROPORTIONATELY BETWEEN MINIMUM AND MAXIMUM AIRFLOW SETTINGS.
7. SEND AN ALARM TO THE BAS OPERATOR INTERFACE IF THE SPACE TEMPERATURE IS MORE THAN 7 F ABOVE OR BELOW SET-POINT.

E. SPLIT SYSTEM AIR CONDITIONING UNIT (ACCU-1/AC-1, ACCU-2/AC-2)

1. SPLIT SYSTEM AIR CONDITIONING UNITS SHALL BE CONTROLLED BY A "MANUFACTURER FURNISHED" THERMOSTAT THAT CAN BE SET IN A WALL-MOUNTED HOLDER NEAR THE DOOR TO THE ROOM, OR BE REMOVED AND USED AS A REMOTE CONTROL FROM ANY LOCATION IN THE ROOM.
2. SPLIT SYSTEM SHALL BE FURNISHED WITH A BACNET CARD FOR MONITORING THROUGH THE BAS.
3. AN ADDITIONAL WALL MOUNTED TEMPERATURE SENSOR SHALL BE INSTALLED IN THIS ROOM BY THE TEMPERATURE CONTROLS CONTRACTOR TO MONITOR ROOM TEMPERATURE THROUGH THE BAS AND SEND AN ALARM TO THE BAS OPERATOR INTERFACE IF SPACE TEMPERATURE RISES 5 F ABOVE SETPOINT.

F. FAN COIL UNITS (FCU-1)

1. THE UNIT FAN SHALL OPERATE CONTINUOUSLY DURING OCCUPIED PERIODS AND ONLY ON A CALL FOR HEAT DURING UNOCCUPIED PERIODS. WHEN THE FAN IS OPERATING DURING OCCUPIED PERIODS, THE MODULATING OUTSIDE, RELIEF, AND RETURN AIR DAMPERS SHALL MEET THE FOLLOWING THREE REQUIREMENTS FOR OUTDOOR AIR:
   A. MAINTAIN MINIMUM OUTDOOR VENTILATION AS DETERMINED BY THE CARBON DIOXIDE SENSOR (START TO OPEN OUTSIDE AIR AT 800 PPM AND BE AT FULL OUTSIDE AIR WHEN 2000 PPM) LOCATED IN THE MAIN RETURN DUCT. OCCUPIED AND UNOCCUPIED PERIODS SHALL BE DETERMINED BY THE PROGRAMS STANDARD TIME SCHEDULING SOFTWARE FOR THE DIGITAL CONTROL.
   B. MAINTAIN THE AMOUNT OF OUTSIDE AIR NECESSARY TO SATISFY ANY EXHAUST REQUIREMENTS. CONTROLS CONTRACTOR SHALL PROVIDE A FLOW SWITCH OR MOTOR CURRENT SENSOR ON THE EXHAUST FAN TO PROVIDE THE OUTSIDE AIR CFM NECESSARY TO MAKE-UP THE EXHAUSTED AIR FROM THE SPACE.
   C. MODULATE THE OUTSIDE, RETURN, AND EXHAUST AIR DAMPERS AND OVERRIDE THE MINIMUM SETTING OF THE CARBON DIOXIDE SENSOR TO PROVIDE COOLING WHEN THE ROOM THERMOSTAT TEMPERATURE SETTING IS EXCEEDED. THE HEATING VALVE WILL BE KEPT CLOSED.
2. WHEN THE ROOM THERMOSTAT IS CALLING FOR HEAT, THE FAN COIL OUTSIDE, RETURN, AND RELIEF AIR DAMPERS SHALL MODULATE IN SEQUENCE TO INTRODUCE THE MINIMUM OUTSIDE AIR. HEATING COIL VALVE SHALL MODULATE OPEN.
3. DURING UNOCCUPIED PERIODS, THE FAN SHALL ONLY OPERATE ON A CALL FOR HEAT. DURING UNOCCUPIED PERIODS THE RETURN DAMPER SHALL BE 100% OPEN; THE EXHAUST AND SUPPLY DAMPERS 100% CLOSED.
4. IF THE LOW TEMPERATURE PROTECTION THERMOSTAT OR FREEZE-STAT LOCATED DOWNSTREAM OF THE STEAM COIL SENSES TEMPERATURES BELOW ITS SET POINT, IT SHALL SHUT DOWN THE UNIT FAN AND OPEN HEATING COIL VALVE FULLY. THE LOWER LIMIT THERMOSTAT MUST BE MANUALLY RESET.
5. PROOF OF FLOW STATUS FOR THE FAN SHALL BE PROVEN TO THE DDC SYSTEM BY A MOTOR CURRENT SWITCH. IF A FAN HAS FAILED AS SENSED BY THE MOTOR CURRENT SWITCH, AN ALARM SHALL BE INDICATED TO THE DDC SYSTEM

G. PACKAGED, INDIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP-AIR UNIT (MAU-1/MAU-2) AND HOOD EXHAUST FAN (EF-1/OWNER FURNISHED SPRAY BOOTH FAN)

1. A MANUAL SWITCH LOCATED ON THE OWNER FURNISHED FUME HOOD OR ON THE WALL ADJACENT TO THE HOOD SHALL START AND STOP THE EXHAUST FAN AND MUA UNIT.
2. A 30 SECOND DELAY SHALL ALLOW THE OUTSIDE AIR DAMPER TO OPEN BEFORE THE MUA SUPPLY FAN STARTS.
3. EXHAUST FAN SHALL BE INTERLOCKED WITH THE MAKE-UP AIR UNIT TO RUN WHENEVER THE MAKE-UP AIR UNIT IS OPERATING.
4. TAB CONTRACTOR SHALL MEASURE THE CFM AND RECORD SPEED AT WHICH ECM MOTOR IS OPERATING TO ACHIEVE PROPER MAKE-UP AND EXHAUST AIR FLOWS. BAS SHALL RECORD AND USE THOSE SPEEDS TO OPERATE BOTH FAN ECM.
5. THE UNIT GAS BURNERS SHALL STAGE TO MAINTAIN A DISCHARGE AIR TEMPERATURE SET-POINT OF 65 F (ADJ), AND ROOM AIR TEMPERATURE SENSOR SHALL RESET DISCHARGE AIR AS NECESSARY TO KEEP FROM OVERHEATING THE SPACE.

H. PACKAGED, OUTDOOR, FIXED PLATE ENERGY RECOVERY UNIT (ERV-1) AND DUCT HEATING COIL (HC-1)

1. SUPPLY AND RETURN FANS SHALL BE OPERATED BY LOCAL TOGGLE SWITCH.
2. TWO-POSITION DAMPERS IN THE OUTSIDE AIR DUCT AND EXHAUST DUCT/RELIEF HOOD SHALL OPEN UPON UNIT ACTIVATION VIA WALL SWITCH. WHEN DAMPERS ARE PROVEN OPEN BY AN END SWITCH, SUPPLY AND RETURN FANS SHALL BE ALLOWED TO START.
3. THE ERV FANS SHALL RUN CONTINUOUSLY.
4. ALL FAN START/STOP FUNCTION AND MOTOR CURRENT SENSOR PROOF OF FLOW SHALL BE THROUGH BAS CONTROLS.
5. SPACE TEMPERATURE SENSORS SHALL MAINTAIN SPACE TEMPERATURE BY MODULATING THE HEATING WATER CONTROL VALVE SERVING THE DUCT HEATING COIL(S) IN THE SUPPLY AIR DUCT.
6. DISCHARGE AIR TEMPERATURE SENSORS LOCATED DOWNSTREAM OF THE HEATING COILS SHALL OVERRIDE THE SPACE TEMPERATURE SENSOR AND MAINTAIN A MINIMUM DISCHARGE AIR TEMPERATURE OF 50 F (ADJ.).
7. AN AVERAGING ELEMENT TYPE FREEZESTAT ON THE DISCHARGE OF THE HEATING COIL SHALL SHUT DOWN THE ERV FANS AND OPEN THE HEATING VALVE TO 100% WHENEVER THE DISCHARGE AIR TEMPERATURE DROPS BELOW 40 F (ADJ).

BAS INPUT/OUTPUT SUMMARY FORM

BANGOR TOWNSHIP SCHOOLS
JOHN GLENN HIGH SCHOOL

SYM.	POINT DESCRIPTION	HARDWARE POINTS: ANALOG INPUT	ANALOG OUTPUT	DIGITAL INPUT	DIGITAL OUTPUT	GRAPHICAL USER INTERFACE: DISPLAY	ADJUST.	ALARM	NOTES
RTU-1 RTU-4 (VAV)	SUPPLY FAN STATUS			X		X		X	
	SUPPLY START/STOP				X	X			
	SUPPLY FAN SPEED		X			X	X		
	OUTSIDE AIR DAMPER COMMAND		X			X	X		
	EXHAUST/RELIEF DAMPER COMMAND		X			X	X		
	MIXED AIR TEMPERATURE	X				X			
	DISCHARGE AIR TEMPERATURE	X				X			
	FREEZE STAT STATUS			X		X		X	
	REFRIGERATION COMMAND				X	X			
	GAS VALVE STAGING				X	X			
	RETURN AIR CARBON DIOXIDE CONCENTRATION	X				X			
	RETURN AIR CARBON DIOXIDE CONCENTRATION SETPOINT					X	X		
	REFRIGERATION OUTSIDE AIR TEMPERATURE ENABLE SETPOINT					X	X		
	OCCUPANCY SCHEDULE					X	X		
(RTU-1) VAV-1 VAV-2 VAV-3 (RTU-4) VAV-4 VAV-5 VAV-6 VAV-7	DISCHARGE AIR TEMPERATURE	X				X			
	SPACE TEMPERATURE LOCAL SETPOINT ADJUSTMENT (THERMOSTAT)	X				X			WITH PUSH BUTTON OVERRIDE
	HEATING COIL VALVE COMMAND		X			X	X		
	DAMPER COMMAND		X			X			
	AIRFLOW SENSOR	X				X			
	SPACE TEMPERATURE SETPOINT					X	X		WITH UNOCCUPIED SETPOINT INPUT AND ADJUSTMENT
	AIRFLOW MIN/MAX SETPOINT					X	X		
	OCCUPANCY SCHEDULE					X	X		
RTU-2 RTU-3 (SINGLE ZONE)	SUPPLY FAN STATUS			X		X		X	
	SUPPLY START/STOP				X	X			
	SUPPLY FAN SPEED		X			X	X		
	OUTSIDE AIR DAMPER COMMAND		X			X	X		
	EXHAUST/RELIEF DAMPER COMMAND		X			X	X		
	MIXED AIR TEMPERATURE	X				X			
	DISCHARGE AIR TEMPERATURE	X				X			
	FREEZE STAT STATUS			X		X		X	
	REFRIGERATION COMMAND				X	X			
	GAS VALVE STAGING				X	X			
	SPACE TEMPERATURE LOCAL SETPOINT ADJUSTMENT (THERMOSTAT)	X				X			WITH PUSH BUTTON OVERRIDE
	RETURN AIR CARBON DIOXIDE CONCENTRATION	X				X			
	SPACE TEMPERATURE SETPOINT					X	X		WITH UNOCCUPIED SETPOINT INPUT AND ADJUSTMENT
	RETURN AIR CARBON DIOXIDE CONCENTRATION SETPOINT					X	X		
	REFRIGERATION OUTSIDE AIR TEMPERATURE ENABLE SETPOINT					X	X		
	OCCUPANCY SCHEDULE					X	X		
	SMOKE DETECTOR								FURNISHED AND INSTALLED BY ELECTRICAL CONTRACTOR. INTERLOCKED TO SUPPLY FAN MOTOR STARTER BY TEMPERATURE CONTROLS CONTRACTOR.
MAU-1	SUPPLY FAN STATUS			X		X		X	
	SUPPLY START/STOP				X	X			INTERLOCK WITH EF-1 OPERATION
	OUTSIDE AIR DAMPER COMMAND		X			X	X		
	DISCHARGE AIR TEMPERATURE	X				X			
	FREEZE STAT STATUS			X		X		X	
	GAS VALVE STAGING				X	X			
	SPACE TEMPERATURE SETPOINT					X	X		WITH UNOCCUPIED SETPOINT INPUT AND ADJUSTMENT
MAU-2	SUPPLY FAN STATUS			X		X		X	
	SUPPLY START/STOP				X	X			INTERLOCK WITH SPRAY BOOTH OPERATION
	OUTSIDE AIR DAMPER COMMAND		X			X	X		
	DISCHARGE AIR TEMPERATURE	X				X			
	FREEZE STAT STATUS			X		X		X	
	GAS VALVE STAGING				X	X			
	SPACE TEMPERATURE SETPOINT					X	X		WITH UNOCCUPIED SETPOINT INPUT AND ADJUSTMENT
EF-1	FAN COMMAND			X		X			INTERLOCK WITH MAU-1 OPERATION
	FAN STATUS			X		X			

SMART BUILDING SERVICES (SBS) IS THE CURRENT TEMPERATURE CONTROLS CONTRACTOR.

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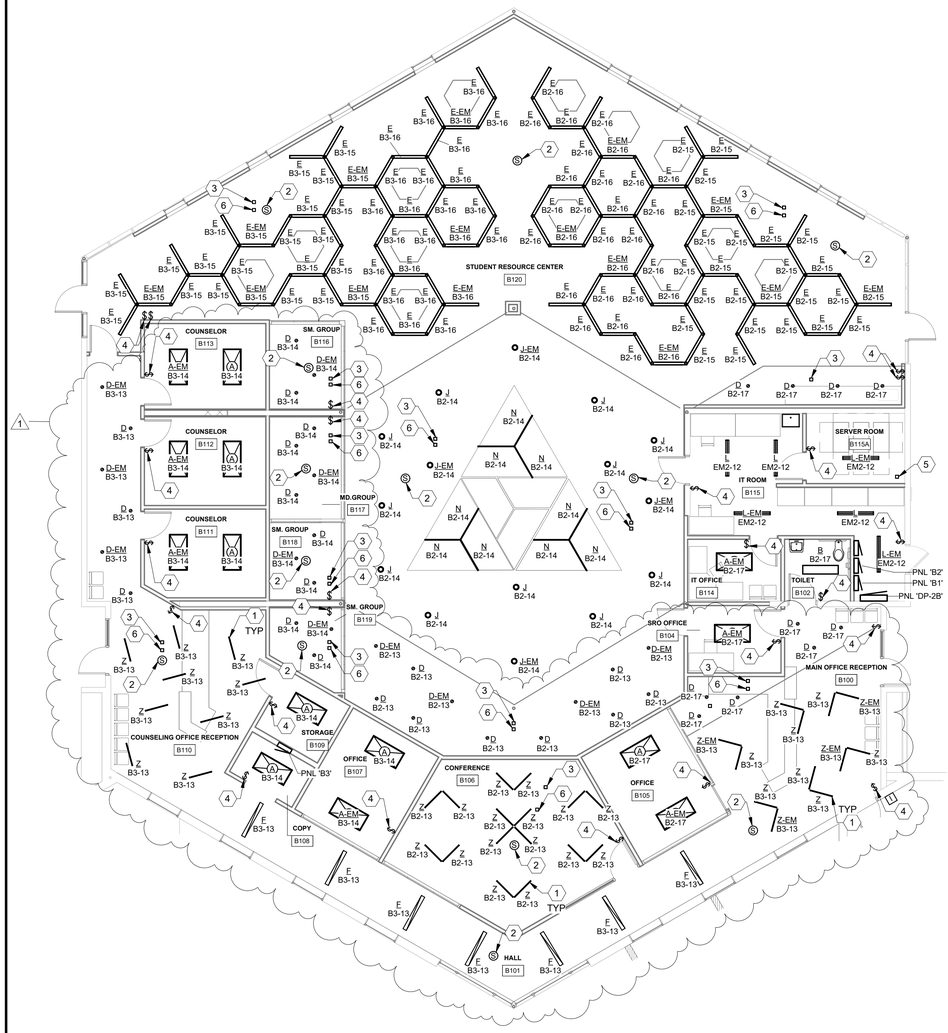
BANGOR TOWNSHIP SCHOOL DISTRICT
PHASE 4 - HIGH SCHOOL RENOVATIONS
3201 KIESEL RD. BAY CITY, MI 48706
PROJECT NO. 22-011

NO.	REVISIONS	DATE
A	DESIGN DEVELOPMENT	07.07.25
B	95% OWNER REVIEW	10.01.25
0	FOR CONSTRUCTION	11.14.25
1	ADDENDUM #1	01.08.26

	BY
DESIGNED	CRP
DRAWN	CRP
CHECKED	SLB
APPROVED	SLB

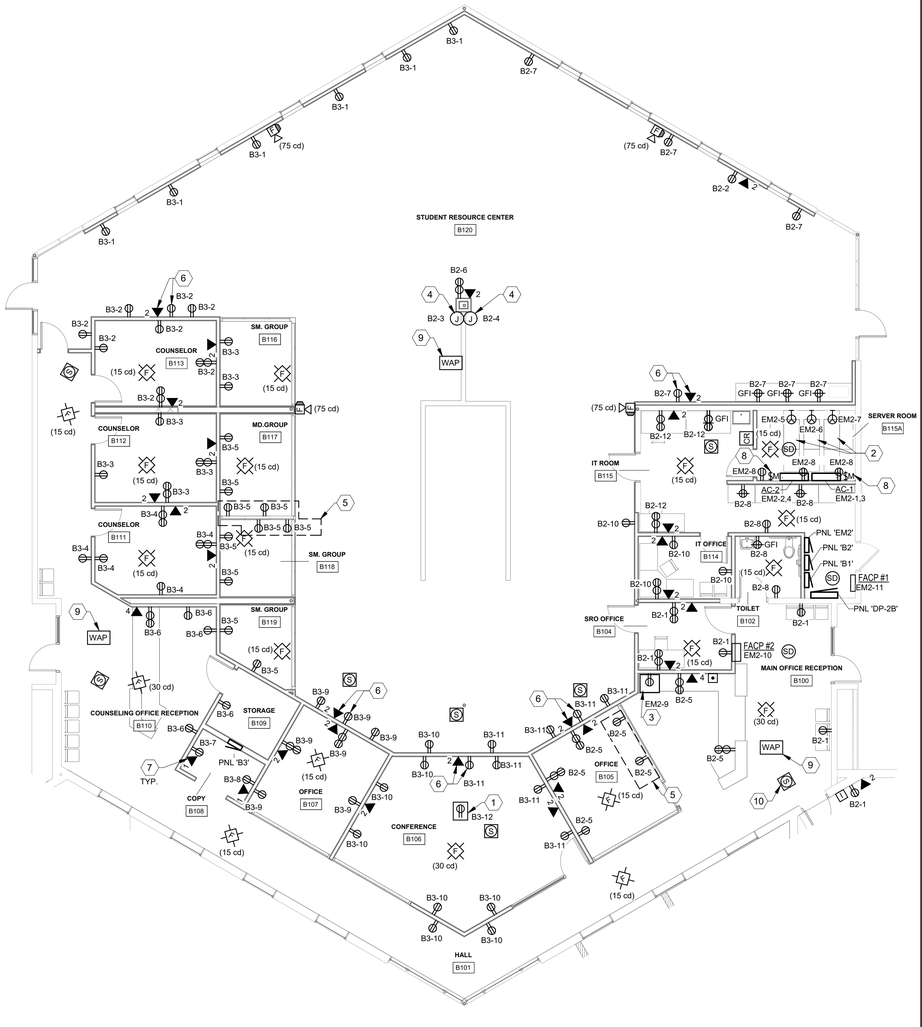
TEMPERATURE CONTROLS

M5.0



1 ELECTRICAL NEW WORK LIGHTING PLAN - AREA 'B'

1/8" = 1'-0"



2 ELECTRICAL NEW WORK POWER PLAN - AREA 'B'

1/8" = 1'-0"

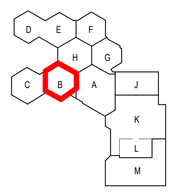
LIGHTING KEYNOTES

1. LIGHT FIXTURE TO BE INSTALLED AS PART OF CEILING GRID.
2. PROVIDE CEILING MOUNTED OCCUPANCY SENSOR. WAVELINX #CWPD-1500, OR EQUAL.
3. PROVIDE WIRELESS SWITCHPACK TO CONTROL FIXTURES ON THIS CIRCUIT. WAVELINX #RSP-P-010-347, OR EQUAL. LOCATION SHOWN FOR REFERENCE ONLY. CONTRACTOR SHALL FIELD LOCATE SWITCHPACK AS PREFERRED IN DISCRETE LOCATION.
4. PROVIDE WAVELINX #W2L-RL-W, 2 BUTTON RAISE/LOWER WALL STATION, OR EQUAL.
5. PROVIDE WAVELINX #WAC2-120 WIRELESS AREA CONTROLLER. COORDINATE EXACT LOCATION WITH OWNER PRIOR TO INSTALLATION. WAC SHALL BE POWERED VIA POE CAT6. INSTALL WAVELINX POWER SUPPLY AND PROVIDE (1) DUPLEX RECEPTACLE TO POWER IT. UTILIZE NEAREST AVAILABLE RECEPTACLE CIRCUIT. PROVIDE (1) CAT6 FROM POWER SUPPLY TO WAC. TERMINATE BOTH ENDS PER SPECIFICATIONS.
6. PROVIDE WIRELESS SWITCHPACK TO CONTROL EMERGENCY FIXTURES ON THIS CIRCUIT. WAVELINX #ESP-P-010-347, OR EQUAL. CONTRACTOR SHALL FIELD LOCATE SWITCHPACK AS PREFERRED IN DISCRETE LOCATION.

POWER KEYNOTES

1. PROVIDE 4 GANG FLUSH FLOOR BOX EQUAL TO LEGRAND EVOLUTION SERIES #EFB45 HOUSING WITH (2) DUPLEX RECEPTACLES AND #EFB45BTCAA SURFACE STYLE COVER. COORDINATE TRENCHING AND EXACT LOCATION WITH ARCHITECTURAL TRADES.
2. COORDINATE WITH OWNER TO INSTALL RELOCATED SERVER RACK. PROVIDE DEDICATED BRANCH CIRCUIT AS INDICATED. COORDINATE WITH OWNER FOR RECEPTACLE MODEL NUMBER PRIOR TO ORDERING.
3. RE-INSTALL PA SYSTEM HEAD-END RACK/EQUIPMENT. EXTEND EXISTING WIRING TO NEW LOCATION. PROVIDE DEDICATED BRANCH CIRCUIT AS INDICATED.
4. PROVIDE DEDICATED CIRCUIT AS INDICATED. PROVIDE CONNECTION TO 'THREAD' SYSTEM PROVIDED BY OTHERS.
5. RECEPTACLES PRE-INSTALLED BY FURNITURE VENDOR. PROVIDE BRANCH CIRCUITRY AS INDICATED.
6. PROVIDE EVOLUTION SERIES #EF5B2 OR EQUAL 2-GANG WALL BOX FOR OWNER PROVIDED TELEVISION. PROVIDE WITH WALL BOX COVER OPTION. COORDINATE EXACT LOCATION AND BOX HEIGHT WITH OWNER PRIOR TO ROUGH-IN. PROVIDE (1) UN-SWITCHED DUPLEX RECEPTACLE AND BRANCH CIRCUITRY AS INDICATED. PROVIDE 1" CONDUIT FROM BOX TO CEILING SPACE. PROVIDE QTY OF CAT-6 CABLES AS INDICATED ON DATA SYMBOL. ROUTE CABLES FROM OUTLET LOCATION TO NETWORK RACK, SEE KEYNOTE #2. TERMINATE BOTH ENDS PER SPECIFICATIONS.
7. PROVIDE SINGLE GANG, DEEP BOX WITH (1) 1" CONDUIT TO CEILING SPACE. PROVIDE PLASTIC BUSHING ON CONDUIT END. COORDINATE EXACT LOCATION WITH OWNER AND FURNITURE DRAWINGS PRIOR TO ROUGH-IN. PROVIDE QTY OF CAT-6 CABLES AS INDICATED ON DATA SYMBOL. ROUTE CABLES FROM OUTLET LOCATION TO NETWORK RACK, SEE KEYNOTE #2. TERMINATE BOTH ENDS PER SPECIFICATIONS. TYPICAL FOR ALL DATA OUTLETS IN THIS AREA.
8. PROVIDE 20A, 2 POLE, SINGLE THROW DISCONNECT (TOGGLE STYLE) SWITCH RECESSED IN WALL NEAR UNIT. PROVIDE BRANCH CIRCUITRY AS INDICATED. INDOOR UNIT IS POWERED VIA OUTDOOR UNIT.
9. INSTALL OWNER PROVIDED WIRELESS ACCESS POINT. PROVIDE (1) CAT-6 FROM WAP LOCATION BACK TO NETWORK RACK IN ROOM B115A. LEAVE 10' NEATLY COILED ABOVE CEILING. TERMINATE BOTH ENDS PER SPECIFICATIONS.
10. INSTALL OWNER PROVIDED PA SPEAKER. COORDINATE WITH OWNER AND OTHER TRADES FOR EXACT LOCATION PRIOR TO INSTALLATION. PROVIDE CABLING BACK TO HEAD-END EQUIPMENT. TYPICAL FOR ALL PA SPEAKERS SHOWN.

KEYPLAN



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BANGOR TOWNSHIP SCHOOL DISTRICT
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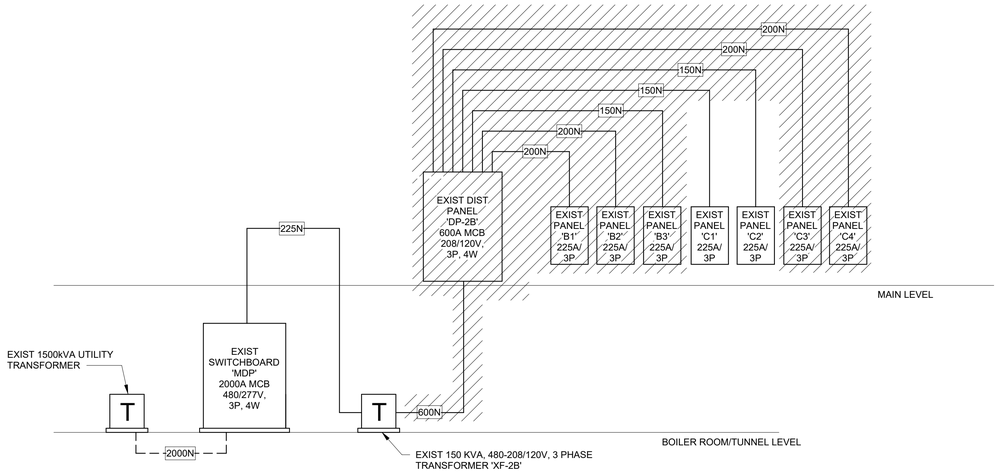
BY	
DESIGNED	SNS
DRAWN	SNS
CHECKED	-
APPROVED	-

ELECTRICAL
NEW WORK PLANS - AREA 'B'

E2.0

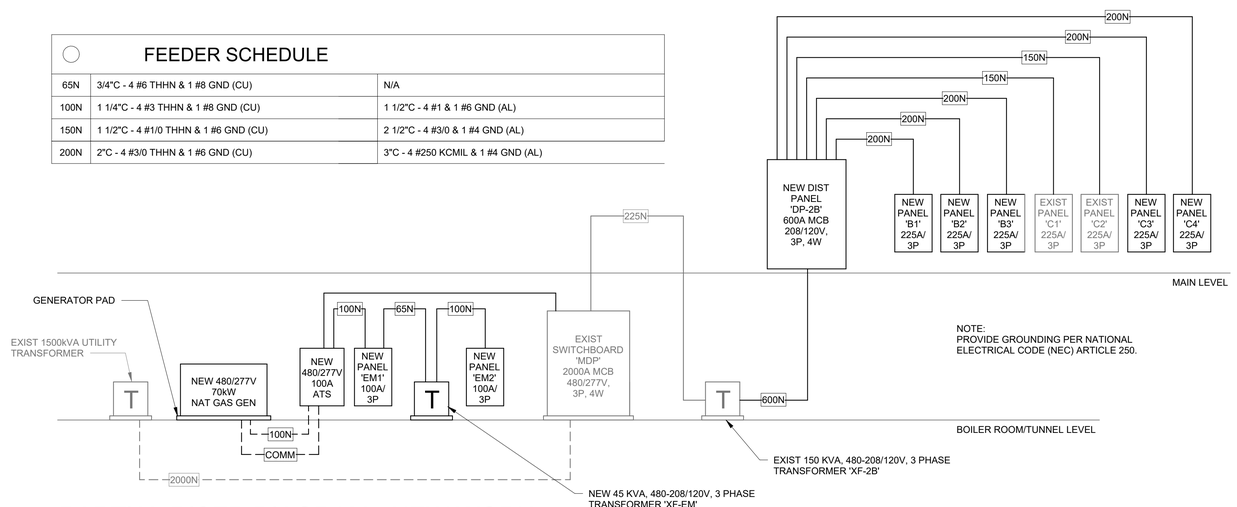


PARTIAL RISER DIAGRAM - EXISTING/DEMO

N.T.S.

LIGHTING FIXTURE SCHEDULE			
TYPE	DESCRIPTION	MANUFACTURER	VOLTS
A	2X4 RECESSED	METALUX #24CZ2-55-UNV-L840-CD1-WPS	UNV
A-EM	2X4 RECESSED	METALUX #24CZ2-55-UNV-EL14W-L840-CD1-WPS	UNV
B	4' SURFACE WRAP	METALUX #4AWWS-L3C3-UNV-WLS	UNV
B-EM	4' SURFACE WRAP EM	METALUX #4AWWS-L3C3-UNV-EL14W-WLS	UNV
C	2' SURFACE WRAP	METALUX #2AWWS-L3C3-UNV-WLS	UNV
C-EM	2' SURFACE WRAP EM	METALUX #2AWWS-L3C3-UNV-EL14W-WLS	UNV
D	RECESSED DOWNLIGHT	ALPHABET #NU6RDSW30LM40K80SS60120DIM10NCWHWH	120V
D-EM	RECESSED DOWNLIGHT EM	ALPHABET #NU6RDSW30LM40K80SS60120DIM10NCWHWH-EM12	120V
E	4' LINEAR PENDANT	CORELITE #SQ2P-F-0U-050D-940-1-D-UNV-STD-CC-UM	120V
E-EM	4' LINEAR PENDANT EM	CORELITE #SQ2P-F-0U-050D-940-1-E-UNV-STD-BSL6-CC-UM	120V
F	4' ACOUSTIC LINEAR PENDANT	BETACALCO#BKFP/LTD1/STT1/DT1/PW02/TR01/SFA0400/SL04/LPF080/LPG000/CR90/CTA40/CTB00/DD3/UDO/V1/DA01/G1/HLA06/AP11/CF01/E0/CS1	120V
G	4' VANITY	WAC LIGHTING #WS-82950-AL	120V
H	2' VANITY	WAC LIGHTING #WS-82925-AL	120V
J	ROUND PENDANT	ALPHABET #BETA-3R-SW-15LM-40K-90-55D-DL-CC-CC-P-120V-DIM10	120V
J-EM	ROUND PENDANT	ALPHABET #BETA-3R-SW-15LM-40K-90-55D-DL-CC-CC-P-120V-DIM10-EM12	120V
K	4' VANDAL RESISTANT	MERCURY LIGHTING #LW25W-4-6500-40K-PF-1%-UNI-VP	120V
K-EM	4' VANDAL RESISTANT EM	MERCURY LIGHTING #LW25W-4-6500-40K-PF-1%-UNI-VP-EM12	120V
L	4' STRIP LIGHT	METALUX #4SNX-SL3-LC-UNV-L840-CD1-WPS	UNV
L-EM	4' STRIP LIGHT	METALUX #4SNX-SL3-LC-UNV-L840-CD1-EL14W-WPS	UNV
M	4' VAPORTIGHT	METALUX #4APVTLD-SL3C3	120V
M-EM	4' VAPORTIGHT EMERGENCY	METALUX #4APVTLD-SL3C3-EL10W	120V
N	4' SURFACE LINEAR	AXIS #STSL-4-SO-400-90-40-C-120-DP-1 (SEE ARCH FOR CEILING TYPE AND MOUNTING REQ.)	UNV
X	EXIT SIGN	SURE-LITES #APCH7RG	UNV
AA	BOLLARD	LIGMAN #FS-USM-10693-RGBW	120V
BB	WALLPACK	MCGRAW-EDISON #GWC-SA1-C-740-U-T4FT-BK	UNV
CC	EXTERIOR SOFFIT	FAIL-SAFE #G12-LD4-20W-40-CL-120V-EDC1-EL5W/CSTG/BLK	120V
DD	TAPE LIGHT	APPROXIMATELY 23' KELVIX #RGBW-2-WR-24V	24V
EE	TAPE LIGHT	APPROXIMATELY 25' KELVIX #RGBW-2-WR-24V	24V
FF	TAPE LIGHT	APPROXIMATELY 26' KELVIX #RGBW-2-WR-24V	24V
GG	TAPE LIGHT	APPROXIMATELY 27' KELVIX #RGBW-2-WR-24V	24V
HH	TAPE LIGHT	APPROXIMATELY 32' KELVIX #RGBW-2-WR-24V	24V
Z	T-BAR FLEX FIXTURE	JLC TECH #TBFL-MN-MO-30-15-DW-A-W-UNV	UNV
Z-EM	T-BAR FLEX FIXTURE EM	JLC TECH #TBFL-MN-MO-30-15-DW-A-W-UNV W/ TBEM-FLEX-12-UNV	UNV

FEEDER SCHEDULE		
65N	3/4"C - 4 #6 THHN & 1 #8 GND (CU)	N/A
100N	1 1/4"C - 4 #3 THHN & 1 #8 GND (CU)	1 1/2"C - 4 #1 & 1 #6 GND (AL)
150N	1 1/2"C - 4 #1/0 THHN & 1 #6 GND (CU)	2 1/2"C - 4 #3/0 & 1 #4 GND (AL)
200N	2"C - 4 #3/0 THHN & 1 #6 GND (CU)	3"C - 4 #250 KCMIL & 1 #4 GND (AL)



NOTE:
PROVIDE GROUNDING PER NATIONAL ELECTRICAL CODE (NEC) ARTICLE 250.

PARTIAL RISER DIAGRAM - NEW WORK

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ELECTRICAL SCHEDULES & DETAILS

E4.2