

ADDENDUM NUMBER TWO

To the Drawings and Project Manual

Dated: January 9, 2025

Entitled:

INDIANA UNIVERSITY
BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072
Chemistry Addition, - Research Labs Renovation -
IU 20240397
Bloomington, Indiana

Prepared By:

BSA LIFESTRUCTURES
175 S. Rangeline Rd.
Carmel, IN 46032



A handwritten signature in black ink, appearing to read "Brent A. Chapman", written over a horizontal dashed line.

Name: Brent Chapman
IN Registration No. AR10800039

Addendum Dated: January 27, 2025

Project Number: 00360477

PREBID MEEETING NOTES

1. Revise paragraph 7 as shown on the attached pre-bid meeting notes.

PREBID QUESTIONS

1. See attached questions and responses.

CHANGES TO THE PROJECT MANUAL

1. Table of Contents:
 - a. Replace the Table of Contents with the attached TOC.
2. Specification Section 087100 Door Hardware:
 - a. Replaced entire section including door hardware sets.
3. Specification Section 081113 RIB-Hollow Metal Doors and Frames:
 - a. Updated to include language for hollow metal doors.
4. Specification Section 087100 Door Hardware:
 - a. Updated as shown in the revised specification section.
5. Specification Section 115313 RIB-Laboratory Fume Hoods:
 - a. Updated to add an approved product manufacturer.
6. Specification Section 123553.13 RIB-Metal Laboratory casework:
 - a. Updated to add an approved product manufacturer.
7. Specification Section 221005 – Plumbing Piping:
 - a. Updated to remove PEX piping.
8. Specification 226654 – Special Waste and Special Vent Piping:
 - a. Add the new specification section.
9. Specification 226713 – Pure Water Piping:
 - a. Add the new specification section.
10. Specification Section 230906 Control Installation Contract:

- a. Paragraph 1.1.A.5.b: The 230906 Control Supplier Drawings (provided by Siemens) are attached to this Addendum.

11. Specification Section 26 05 33.23 – Surface Raceways for Electrical Systems

- a. Add the new specification section to include specific raceways to be used on this project.

12. Specification Section 27 00 01 – Communications

- a. Add the new specification section including IU telecommunications standards

CHANGES TO THE DRAWINGS

1. DRAWING SHEETS G000, A000, A002, A104, A111A, A111B, A130, A131A, A131B, A132, A500, LF000.Y, LF001.Y, LF411A, LF601, M211, M213, P100, P101, P102, P200, P200', P201, P204, P210, P211, P212, P213, P400, P401, P402, P403, P404, P405, P406, P500, FP123, E110, E301, E310, E311, E312, E320, E600, E602, E603, and E604.
 - a. See the attached full sized revised sheets.

END OF ADDENDUM NUMBER TWO

Attachments: Siemens Control Drawings, Full sized revised sheets G000, A000, A002, A104, A111A, A111B, A130, A131A, A131B, A132, A500, LF000.Y, LF001.Y, LF411A, LF601, M211, M213, P100, P101, P102, P200, P200', P201, P204, P210, P211, P212, P213, P400, P401, P402, P403, P404, P405, P406, P500, FP123, E110, E301, E310, E311, E312, E320, E600, E602, E603, and E604. Revised and additional specification sections Section 087100 Door Hardware, Section 081113 RIB-Hollow Metal Doors and Frames, Section 115313 RIB-Laboratory Fume Hoods, Section 123553.13 RIB-Metal Laboratory casework, Section 221005 Plumbing Piping, Section 226654 Special Waste and Special Vent Piping, Section 26 05 33.23 – Surface Raceways for Electrical Systems, and Section 27 00 01 – Communications.

PRE-BID / SITE WALK THROUGH MEETING NOTES

Project: BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072 Chemistry Addition – Research Labs Renovation; IU Project 20240397

Date: 16 January 2025

Location: Chemistry Building Room 127 – Indiana University Bloomington, IN

1. Contractor Sign-In: See the attached sign in sheets for a list of attendees
2. Project Personnel:
 - a. IU Team Lead: Shih-Ping Lin, linsp@iu.edu
 - b. IU Construction Manager: David Riffel, dariffel@iu.edu
 - c. BSA Project Architect: Brent Chapman, bchapman@bsalifestructures.com
 - d. BSA Contract Manager: Patrick Mendel, pmendel@bsalifestructures.com
3. General Review of Project Scope:
 - a. All contractors are required to review all of the documents. Additional compensation will not be considered for work shown on drawings other than drawings for his / her primary trade.
 - b. Release of documents: - posted to Eastern Engineering Plan Room
 - c. Planned Addendum #1: January 17, 2025 – to be issued via EE plan room
 - d. Planned Addendum #2: January 27, 2025 – to be issued via EE plan room
 - e. Last day for Pre-bid RFI – January 24, 2025
 - f. Last day for product review requests – January 24, 2025
 - g. Bidding Procedure – one unified contract including all work shown on the documents. See the documents for the items required to accompany the bid.
 - h. Bids Due – February 6, 2025
 - i. Bid opening by virtual meeting.
 - j. Brief project description was presented by Brent Chapman
 - k. Alternates – see alternate descriptions for pricing requirements
4. Schedule: Phase Description and Room by Room completion dates have been bound in the project manual, Section 01 10 00 Summary.
5. Post-Bid Information:
 - a. Subcontractor and Material Listing: Submit within 48 hours of bids being due.
6. Review of Project Procedures:
 - a. Contractor and Employee Parking – Parking is available in the Green Lot near 17th and Fee

streets. Transportation to and from any provided parking is the responsibility of the Contractor.

- b. Material Staging: There are no material staging locations provided by IU. Materials must be brought in as needed. Delivery vehicles shall not be left unattended.
- c. Dumpster placement: While there is currently no planned dumpster placement near the projects' buildings, IU will look for locations that may be possible as the requirement draws near.
- d. Access to the project sites: The Contractor's route in and out of the buildings will be shared with staff and students. IU will provide access to the various areas required by way of credentials on Crimson cards, or with construction cores and keys as later determined best for the specific condition.
- e. Submittals – IU's document management platform eBuilder will be used for submittals
- f. Construction Coordination Requirements / Progress Schedule Updates – Contractor is required to attend bi-weekly progress meeting, provide schedule updates, and have supervision on site whenever work is being performed.
- g. Pay Requests – monthly pay requests based on the progress of work will be submitted to A/E for review and then on to IU for payment via IU's eBuilder project management platform.
- h. RFI Procedures
 - i. Pre-bid RFI shall be submitted to Brent Chapman, copying Shih-Ping Lin and David Riffle
 - ii. Construction RFI shall be submitted via the project's project management platform

7. Work Scheduling Requirements: **Refer to 01 00 00 General Requirements by IU CPF.**

- a. ~~Normal working hours – normal working hours vary between buildings, but buildings generally open between 6-7 a.m. and close between 7-10 p.m.~~
- b. ~~Off hours work – as necessary to minimize or eliminate disruptions to the building occupants. Building occupants will be sensitive to noise and vibration, including that associated with hammer drilling and other similar activities. Those activities creating noise and vibration, as well as activities that require a disruption to any utility service should be discussed with IU 72 hours prior to scheduling that work.~~
- c. ~~While all of the project areas are adjacent to spaces where building occupants will remain in place, and sensitivity to noise and vibration are important, the areas in Swain are particularly sensitive, especially Rooms 011, 013 and 014.~~

8. Temporary Barriers:

- a. All work shall be separated from adjacent spaces with temporary measures, including but not limited to secure temporary partitions and HVAC filters, that prevent the migration of dust and noise to adjacent spaces. This is a general requirement for which specific locations have not been shown on the documents.

9. Procedures for Utility shutdowns – work with IU team leads and others to perform necessary work with minimal disruptions to utility services.

10. Architect's Supplemental Information (ASI)/Construction Change Directives (CCD)/Change Orders:

- a. ASI will be issued for all changes. Contractors will submit a change order request for those items that involve changes to cost or schedule.
- b. If approved, a CCD will be issued to document the change.

c. Work involving changes to cost or time shall not proceed without clear approval from IU.

11. Closeout – IU requires a close out process that includes the Contractor's participation in providing COBie data placement into the utilized format, as-built drawings, Operations and Maintenance Manuals, Warranty manuals, and other items described in the documents.

12. Questions:

a. No questions

13. Site walk through:

a. The group walked each of the project areas with representatives of the various buildings.

i. David Sprinkle – Swain West

ii. John Morrow – Simon Hall

iii. Chad Schaeffer - Chemistry

Questions:

1. Can you please provide a plumbing schedule? For all building that are included on this project.
 - Or clarify if the fixtures that are shown on the drawings are provided by owner and the PC is just to install?

Response: All sinks are Contractor Furnished Contractor Installed.

2. Clarification on what the cabinets in the labs include in all labs throughout the project (Swain West, Simon Hall, and Chemistry/Addition).
 - Do these include the lab sinks already installed is the PC just connecting to the med gas, sanitary, and water?
 - If not, what sinks need to be quoted?

Response: Sinks within the lab casework are specified within Section 12 35 53.13 Metal Laboratory Casework. Review installation requirements with the casework manufacturer

3. We are noticing multiple areas where new sinks are being added, but no sanitary piping is shown feeding these sinks. Please review the plumbing drawings and see if a layer might be turned off, or if sanitary drawings are missing?

Response: See Addendum No. 2.

4. Addendum #1, Pre-Bid Notes #7 Working Schedule Requirements, a.) states that working hours vary between buildings. Please provide a normal working hours for each building.

Response: Delete Paragraph 7 from the prebid meeting notes. Refer to IU 01 00 00 General Requirements.

5. Addendum #1, Pre-Bid Notes #7 Working Schedule Requirements, b.) states that off hours work is to be as necessary, specifically due to activities that create noise and vibration. Will unloading/loading material into these spaces be allowed during normal working hours, will hand held drills, hammers, Sawzall tools be allowed? Please advise exactly what work activities are not allowed during normal working hours.

Response: Delete Paragraph 7 from the prebid meeting notes. Refer to IU 01 00 00 General Requirements.

Questions:

6. Addendum #1, Pre-Bid Notes #7 Working Schedule Requirements, c.) states that areas in Swain, especially rooms 011, 013, and 014 are sensitive to noise and vibration. Are we to assume that ALL work in/around these spaces are to be done off hours? If so, please advise exactly which areas need to be considered for off hours work.

Response: Delete Paragraph 7 from the prebid meeting notes. Refer to IU 01 00 00 General Requirements.

7. Can you please provide a detailed Schedule of activities/student testing days for each building, so that we are able to determine our schedule for each building.

Response: Delete Paragraph 7 from the prebid meeting notes. Refer to IU 01 00 00 General Requirements.

8. Will the schedule for these buildings be staggered, or will be working in each area, or each building at the same time.

Response: Work may proceed simultaneously within the phase start and finish dates and sequencing as described in Specification Section 01 10 00 Summary and its related attachments.

9. Can you provide an expected completion date for each area, of each building?

Response: Work may proceed simultaneously within the phase start and finish dates and sequencing as described in Specification Section 01 10 00 Summary and its related attachments.

10. Can you please a more detailed spec for the lab tubing? For all the med gas and lab gases. There is a general spec but does not say what is needed for what material being used.

Response: See Addendum No. 2.

11. What is the material spec for HV piping? This is not listed on the piping symbols schedule.

Response: See Addendum No. 2.

12. What is the material spec for DI piping? This is not listed on the piping symbols schedule.

Questions:

Response: See Addendum No. 2.

13. What is the material spec for the special waste and vent piping? Is this the same material as the waste and vent piping that is listed in the specs? (cast iron)

Response: See Addendum No. 2.

14. The specs state that PEX piping is allowed, is this correct?

Response: See Addendum No. 2.

SECTION 00 01 10
TABLE OF CONTENTS
Edited with
Addendum No 2

PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

- 00 01 02 - Project Information
- 00 01 03 - Project Directory
- 00 01 11 - IU CPF Procurement Division 00 and 01
- 00 31 00 - Available Project Information
- 00 43 25 - Substitution Request Form - During Bidding
- 00 43 30 - Proposed Subcontractor and Material Form
- 00 63 25 - Substitution Request Form - During Construction

SPECIFICATIONS

DIVISION 01 -- GENERAL REQUIREMENTS

- 01 10 00 - Summary
- 01 23 00 - Alternates
- 01 25 00 - Substitution Procedures
- 01 30 00 - Administrative Requirements
- 01 32 16 - Construction Progress Schedule
- 01 40 00 - Quality Requirements
- 01 42 19 - Reference Standards
- 01 50 00 - Temporary Facilities and Controls
- 01 60 00 - Product Requirements
- 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- 01 70 00 - Execution and Closeout Requirements
- 01 74 19 - Construction Waste Management and Disposal
- 01 78 00 - Closeout Submittals
- 01 79 00 - Demonstration and Training

DIVISION 02 -- EXISTING CONDITIONS

- 02 41 00 - Demolition

DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

- 06 10 00 - Rough Carpentry

DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

- 07 26 00 – Vapor Retarders
- 07 84 00 - Firestopping
- 07 92 00 - Joint Sealants

DIVISION 08 -- OPENINGS

- 08 11 13 - Hollow Metal Doors and Frames
- 08 14 16 - Flush Wood Doors
- 08 31 00 - Access Doors and Panels
- 08 71 00 - Door Hardware
- 08 80 00 – Glazing

DIVISION 09 -- FINISHES

- 09 05 61 – Common Work Results for Flooring Preparation
- 09 21 16 – Gypsum Board Assemblies
- 09 51 00 - Acoustical Ceilings
- 09 65 00 – Resilient Flooring
- 09 68 13 - Tile Carpeting
- 09 91 23 - Interior Painting

DIVISION 10 -- SPECIALTIES

- 10 26 00 - Wall and Door Protection
- 10 28 00 - Toilet, Bath, and Laundry Accessories
- 10 44 00 - Fire Protection Specialties

DIVISION 11 -- EQUIPMENT

- 11 53 13 - Laboratory Fume Hoods

DIVISION 12 -- FURNISHINGS

- 12 35 53.13 - Metal Laboratory Casework

DIVISION 21 -- FIRE SUPPRESSION

- 21 05 00 - Common Work Results for Fire Suppression
- 21 05 48 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment
- 21 05 53 - Identification for Fire Suppression Piping and Equipment
- 21 11 00 - Facility Fire-Suppression Water-Service Piping
- 21 13 00 - Fire-Suppression Sprinkler Systems

DIVISION 22 -- PLUMBING

- 22 05 13 – Common Motor Requirements for Plumbing Equipment
- 22 05 17 - Sleeve and Sleeve Seals for Plumbing Piping
- 22 05 19 – Meters and Gauges for Plumbing Piping
- 22 05 23 - General-Duty Valves for Plumbing Piping
- 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment
- 22 05 53 – Identification for Plumbing Piping and Equipment
- 22 07 19 – Plumbing Piping Insulation
- 22 07 19.11 – Under-Lavatory Pipe and Supply Covers
- 22 10 05 – Plumbing Piping
- 22 10 06 – Plumbing Piping Specialties
- 22 40 00 – Plumbing Fixtures
- 22 45 00 – Emergency Plumbing Fixtures
- 22 61 14 - Laboratory High-Purity Specialty Gas Piping Systems
- 22 66 00 – Chemical-Waste Systems for Laboratory and Healthcare Facilities
- 22 66 54 – Special Waste and Special Vent Piping**
- 22 67 13 – Pure Water Piping**

DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

- 23 05 00 – Common Work Results for HVAC
- 23 05 13 – Common Motor Requirements for HVAC Equipment
- 23 05 19 - Meters and Gauges for HVAC Piping
- 23 05 23 – General Duty Valves for HVAC Piping
- 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- 23 05 49 - Vibration Control for HVAC Piping and Equipment
- 23 05 53 - Identification for HVAC Piping and Equipment
- 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- 23 05 95 - Certification of Fume Hood
- 23 07 00 - HVAC Insulation
- 23 09 06 - Control Installation Contract
- 23 21 13 - Hydronic Piping
- 23 21 21 - Process Cooling Water Piping (stainless)
- 23 21 22 - Process Cooling Water Piping (CPVC)
- 23 25 00 - HVAC Water Treatment
- 23 31 13 - Metal Ducts

- 23 33 00 - Air Duct Accessories
- 23 34 16 - Centrifugal HVAC Fans
- 23 36 00 - Air Terminal Units
- 23 37 13 – Diffusers, Registers, and Grilles
- 23 73 13 - Modular Indoor Air-Handling Units
- 23 84 16 – Dehumidification Units
- 23 82 16 - Air Coils
- 23 82 33 - Commercial Finned Tube Radiators

DIVISION 26 – ELECTRICAL

- 26 05 05 – Selective Demolition for Electrical
- 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- 26 05 26 - Grounding and Bonding for Electrical Systems
- 26 05 29 - Hangers and Supports for Electrical Systems
- 26 05 33.13 - Conduit for Electrical Systems
- 26 05 33.16 - Boxes for Electrical Systems
- 26 05 33.23 – Surface Raceways for Electrical Systems
- 26 05 53 - Identification for Electrical Systems
- 23 05 73 - Power System Studies
- 26 09 23 - Lighting Control Devices
- 26 24 16 - Panelboards
- 26 27 26 - Wiring Devices
- 26 28 13 - Fuses
- 26 28 16.13 – Enclosed Circuit Breakers
- 26 28 16.16 – Enclosed Switches
- 26 29 23 - Variable-Frequency Motor Controllers
- 26 51 00 - Interior Lighting

DIVISION 27 – COMMUNICATIONS

- 27 00 01 - Communications
- 27 05 29 - Hangers and Supports for Communication Systems
- 27 05 33 - Conduit for Communication Systems
- 27 05 36 - Cable Trays for Communication Systems
- 27 10 00 - Structured Cabling**

DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

- 28 46 00 - Fire Detection and Alarm

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry,
BL072 Chemistry Addition - Research Labs Renovation
Bloomington, Indiana
IU 20240397; BSA# 00360477

END OF SECTION

This page intentionally left blank

SECTION 08 11 13 HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.**
- B. Hollow metal frames for wood doors.
- C. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 91 23 - Interior Painting: Field painting.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Samples: Submit two samples of metal, 2 by 2 inches in size, showing factory finishes, colors, and surface texture.
- E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: <https://steeldoors.org/sdi-certified/#sle>.**
- B. Maintain at project site copies of reference standards relating to installation of products specified.**

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. MPI: www.metalproductsinc.com/sle#.

4. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
5. Steelcraft, an Allegion brand: www.allegion.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. **Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.**
 4. **Door Edge Profile: Manufacturers standard for application indicated.**
 5. **Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.**
 6. **Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.**
 7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) for corrosive locations.
- B. **Hollow Metal Panels: Same construction, performance, and finish as doors.**
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. **Door Finish: Factory primed and field finished.**
- B. **Type HM ,Interior Doors, Non-Fire-Rated:**
 1. **Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).**
 - a. **Level 2 - Heavy-Duty.**
 - b. **Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.**
 - c. **Model 2 - Seamless.**
 - d. **Door Face Metal Thickness: 18 gauge, 0.042 inch; minimum.**
 - e. **Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.**
 2. **Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.**
 3. **Door Thickness: 1-3/4 inches, nominal.**
 4. **Door Face Sheets: Flush .**
 5. **Door Finish: Factory primed and field finished.**

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.

1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
 - a. 14 gauge, 0.067 inch minimum for openings over 4 feet, lead lined frames, and frames with automatic openings.
2. Frame Finish: Factory primed and field finished.
- C. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- D. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- E. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- D. **Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.**
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. **Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.**
- B. Install prefinished frames after painting and wall finishes are complete.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 08 71 00.
- F. Comply with glazing installation requirements of Section 08 80 00.
- G. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.**
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

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 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
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 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
7. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
8. 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. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
 - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - c. 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.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

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) Exit Devices
 - a) Von Duprin: 10 years
 - 2) Closers
 - a) LCN 4000 Series: 30 years
 - b. Electrical Warranty
 - 1) Exit Devices
 - a) Von Duprin: 3 years

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. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 2. Use materials which match materials of adjacent modified areas.
 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. 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.
- D. 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

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. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
9. 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
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

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

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.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

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.

2.06 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

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.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Best 45 – No Substitutions, Owner Standard

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
 - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
 - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
 - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.

5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

2.08 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. BEST

B. Requirements:

1. The IU Construction Manager will arrange a meeting between the building user representative and the university locksmith to determine key control and keying requirements.
2. During the construction phase, it will be the responsibility of the Contractor to provide temporary construction lock cores for job site security.
3. The university locksmith will coordinate with the lock core supplier on master
4. keying of buildings.
5. On all projects, the university's locksmith will install lock cores and cut the keys for
6. distribution to building occupants.
7. Specify a minimum of three blank keys for each key core to be furnished to the
8. university locksmith
9. At no time is the Contractor to furnish or possess key cores, grand master, master, or door keys.
10. Do not specify key cabinets for buildings.

2.09

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 99/33A series – No Substitutions, Owner Standard

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 grooved 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.

2.11 ACCESS CONTROL READER

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage MTB Series

B. Requirements:

1. Provide access control card readers manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications are not acceptable.
2. Provide multi-technology contactless readers complying with ISO 14443.
3. Provide access control card readers capable of reading the following technologies:
 - a. CSN - DESFire® CSN, HID iCLASS® CSN, Inside Contactless PicoTag® CSN, ST Microelectronics® CSN, Texas Instruments Tag-It®, CSN, Phillips I-Code® CSN
 - b. 125 KHz proximity - Schlage® Proximity, HID® Proximity, GE/CASI® Proximity, AWID® Proximity, LenelProx®
 - c. 13.56 MHz Smart card - Schlage smart cards using MIFARE Classic® EV1/EV3, Schlage smart cards using MIFARE Plus®, Schlage smart cards using MIFARE® DESFire® EV1/EV3, Schlage smart cards using MIFARE® DESFire® EV2/EV3
 - d. 13.56 MHz NFC (mobile), 2.45 GHz Bluetooth (mobile) - Mobile means compatible with Bluetooth and NFC-enabled smartphones.

2.12 ELECTRIC STRIKES

A. Manufacturers and Products:

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

2.13 POWER SUPPLIES

A. Manufacturers and Products:

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

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series - No Substitutions, Owner Standard
 - b.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. 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 piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
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. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
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 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.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.15 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

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.

2.16 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

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.

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

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Zero International

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.

2.18 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

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.

2.19 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 622/631 (US19); EXCEPT:

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

C. FINISH: BHMA 619/646 (US15); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Door Closers: Powder Coat to Match
4. Latch Protectors: BHMA 630 (US32D)
5. Weatherstripping: Clear Anodized Aluminum
6. Thresholds: Mill Finish Aluminum

D. FINISH: BHMA 625/651 (US26); EXCEPT:

1. Hinges at Exterior Doors: BHMA 629 (US32)
2. Push Plates, Pulls, and Push Bars: BHMA 629 (US32)
3. Protection Plates: BHMA 629 (US32)
4. Overhead Stops and Holders: BHMA 629 (US32)
5. Door Closers: Powder Coat to Match
6. Wall Stops: BHMA 629 (US32)
7. Latch Protectors: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

E. FINISH: BHMA 612/639 (US10); EXCEPT:

1. Door Closers: Powder Coat to Match
2. Latch Protectors: BHMA 630 (US32D)
3. Weatherstripping: Dark Bronze Anodized Aluminum
4. Thresholds: Extruded Architectural Bronze – Mill Finish

F. FINISH: BHMA 613/640 (US10B); EXCEPT:

1. Door Closers: Powder Coat to Match.
2. Latch Protectors: US32D (BHMA 630).
3. Weatherstripping: Dark Bronze Anodized Aluminum.
4. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

G. 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
- H. FINISH: BHMA 605/632 (US3); EXCEPT:
1. Door Closers: Powder Coat to Match
 2. Latch Protectors: BHMA 630 (US32D)
 3. Weatherstripping: Gold Anodized Aluminum.
 4. Thresholds: Mill Finish Gold
- I. FINISH: BHMA 606/633 (US4); EXCEPT:
1. Door Closers: Powder Coat to Match
 2. Latch Protectors: BHMA 630 (US32D)
 3. Weatherstripping: Gold Anodized Aluminum
 4. Thresholds: Mill Finish Gold
- J. FINISH: BHMA 630 (US32D); EXCEPT:
1. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
 2. Door Closers: Powder Coat to Match
 3. Weatherstripping: Clear Anodized Aluminum
 4. Thresholds: Mill Finish Aluminum
- K. SILVER ION COATINGS
1. Furnish antimicrobial coated hardware items designed with AM suffix to the finish.
 2. The non-toxic coating to be natural inorganic silver-ion based antimicrobial added to the clear coating.
 3. The powder coat containing the antimicrobial compound to be electro-statically applied to a minimum thickness of 1.5 mils.
 4. The antimicrobial coatings are to protect the surface of the hardware item by inhibiting the growth of bacteria, mold, mildew, and odor.
 5. Provide antimicrobial coating passing the BHMA clear coat requirements and be registered with the EPA and FDA listed.
- L. COPPER COATINGS
1. Furnish antimicrobial coated hardware components designated with 361 finish. The applied coating must be recognized by the EPA as an anti-microbial /bactericidal surface and must retain its efficacy for life of product. The coating must be applied to an SSPC-SP 5 prepared surface with an average thickness of 0.004 inches (0.1016mm) post finishing operations. The product must be manufactured with EPA registration #85353-1 meeting all marking and packaging requirements contained therein.
 - a. Mortise Locks: Levers, Roses, and Bushings
 - b. Cylindrical Locks: Levers and Rose
 - c. Exit Devices: Push Bar Assembly and Lever Trim
 - d. Hospital Latch: Paddles
 - e. Push Plates and Pulls: all exposed surfaces front and back

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. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 - 2. Field modify and prepare existing doors and frames for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 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. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. 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.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. 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.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

- Q. 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.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 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. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. 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.

3.05 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.

3.06 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.

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry,
BL072 Chemistry Addition - Research Labs Renovation
Bloomington, Indiana
IU 20240397; BSA# 00360477

-
- 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:

125553 OPT0405767 Version 3

Legend:

 Link to catalog cut sheet
 Electrified Opening

Hardware Group No. 1

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	OFFICE LOCKSET	45H-7-A-14-H	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 2

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	CLASSROOM LOCKSET	45H-7-T-14-H-VIT	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	SILENCER	SR64	GRY	IVE

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry,
 BL072 Chemistry Addition - Research Labs Renovation
 Bloomington, Indiana
 IU 20240397; BSA# 00360477

Hardware Group No. 3

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	PANIC HARDWARE	CDSI-9927-DT-LBR	626	VON
1	EA	PANIC HARDWARE	CDSI-9927-NL-LBR	626	VON
2	EA	MORTISE ADA CYL TURN	09-9XX NH 114 XB11-720(ADA) XQ11-948(INVERTED CAM) X STRAIGHT CAM X COLLAR AS REQ'D	626	SCH
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
2	EA	SURFACE CLOSER (W/ STOP)	4040XP SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 4

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	OFFICE LOCKSET	45H-7-A-14-H	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
1	EA	OH STOP	100S	630	GLY
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 5

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	AUTO FLUSH BOLT	FB41B	630	IVE
1	EA	PASSAGE LOCKSET	45H-0-A-14-H	626	BES
1	EA	COORDINATOR	COR X FL (MB AS REQ'D)	628	IVE
2	EA	SURFACE CLOSER (W/ STOP)	4040XP SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry,
 BL072 Chemistry Addition - Research Labs Renovation
 Bloomington, Indiana
 IU 20240397; BSA# 00360477

Hardware Group No. 6

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	AUTO FLUSH BOLT	FB41B	630	IVE
1	EA	STOREROOM LOCKSET	45H-7-D-14-H	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
1	EA	ELECTRIC STRIKE	6211 FSE 12/24 VAC/VDC	✓ 630	VON
1	EA	COORDINATOR	COR X FL (MB AS REQ'D)	628	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MTB11/MTB15 BY DIV 28	✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 BY DIV 28	✓	VON
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER
 MOMENTARILY RELEASES ELECTRIC STRIKE, ALLOWING ACCESS. DOOR TO REMAIN LOCKED
 UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Hardware Group No. 7

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	STOREROOM LOCKSET	45H-7-D-14-H	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
1	EA	ELECTRIC STRIKE	6211 FSE 12/24 VAC/VDC	✓ 630	VON
1	EA	SURFACE CLOSER (W/ STOP)	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MTB11/MTB15 BY DIV 28	✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 BY DIV 28	✓	VON
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER
 MOMENTARILY RELEASES ELECTRIC STRIKE, ALLOWING ACCESS. DOOR TO REMAIN LOCKED
 UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry,
 BL072 Chemistry Addition - Research Labs Renovation
 Bloomington, Indiana
 IU 20240397; BSA# 00360477

Hardware Group No. 8

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ'D)	652	IVE
1	EA	AUTO FLUSH BOLT	FB41B	630	IVE
1	EA	STOREROOM LOCKSET	45H-7-D-14-H	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
1	EA	PERMANENT CORE	BY OWNER	626	BES
1	EA	ELECTRIC STRIKE	6211 FSE 12/24 VAC/VDC	✓ 630	VON
1	EA	COORDINATOR	COR X FL (MB AS REQ'D)	628	IVE
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33/WS33X	626	IVE
2	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MTB11/MTB15 BY DIV 28	✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 BY DIV 28	✓	VON
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL TO READER
 MOMENTARILY RELEASES ELECTRIC STRIKE, ALLOWING ACCESS. DOOR TO REMAIN LOCKED
 UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Door#	HwSet#
103E	1
105	1
140-1	2
140-2	3
140A	1
150	4
150A	1
150B	1
150C	1
S20	5
S20A	6
S20B	7
S20C	8

SECTION 11 53 13 LABORATORY FUME HOODS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Standard laboratory fume hoods, prepared for face velocity monitor to be installed by Division 23 contractor.
- B. Work surfaces.
- C. Service fittings and outlets.
- D. Airflow indicators and alarms.
- E. Piping within fume hoods for service fittings.
- F. Wiring within fume hoods for light fixtures and receptacles.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring fume hoods.
- B. Section 09 21 16 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring fume hoods.
- C. Section 09 22 16 - Non-Structural Metal Framing: Reinforcements in metal-framed partitions for anchoring fume hoods.
- D. Section 09 65 00 - Resilient Flooring: Resilient base applied to base cabinets.
- E. Section 12 35 53.13 - Metal Laboratory Casework: Additional requirements for base cabinets for fume hoods.
- F. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Field quality-control testing of fume hoods.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide fume hood exterior and interior dimensions and construction, utility and service requirements and locations.
- C. Shop Drawings: Indicate locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, locations and types of service fittings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Provide documentation of successful Factory Acceptance Testing.
- E. Test Reports: Indicate that each type of fume hood has been factory-tested and meets specified ASHRAE Std 110 (AM) requirements.
- F. Operation Data: Include description of equipment operation and required adjusting and testing.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- H. Project Record Documents: Record actual locations of concealed utility connections.

1.04 QUALITY ASSURANCE

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

- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preconstruction Testing: Factory-test each type of hood as per referenced standard.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.06 FIELD CONDITIONS

- A. Ambient Conditions: Maintain temperature and relative humidity at occupancy levels during and after installation of fume hoods.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide one year manufacturer warranty for manufacturer's standard items (listed by part number in manufacturer's official publication).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Laboratory Fume Hoods:
 - 1. Kewaunee Scientific Corp: www.kewaunee.com, Supreme Air Venture series
 - 2. Mott Manufacturing Ltd: www.mott.ca, RFV2
 - 3. Labconco Corporation; www.labconco.com, Xstream
 - 4. Air Master Systems
 - 5. **Lab Crafters, Inc: www.lab-crafters.com, Air Sentry**
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 VARIABLE AIR VOLUME (VAV) FUME HOODS

- A. Restricted-Bypass Fume Hoods:
 - 1. Provide a compensating bypass arrangement above the sash to open after sash is closed to less than 20 percent open. Bypass to maintain exhaust capacity of at least 100 CFM per square foot of work surface regardless of sash position.

2.03 PERFORMANCE REQUIREMENTS

- A. Fume hoods complying with the following when tested in accordance with ASHRAE Std 110:
 - 1. As-Manufactured (AM) Rating: AM 0.01 (0.01 ppm).
 - 2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
 - 3. Average Face Velocity: 100 FPM (0.51 m/s) plus or minus 10 percent with sashes fully open.
 - 4. Face-Velocity Variation: Not more than 10 percent of average face velocity across the face opening with sash(es) fully open.
 - 5. Release Rate: 4.0 L/min.
 - 6. Static-Pressure Loss: Not more than 1/2-inch w.g. (124 Pa) at 100 FPM (0.51 m/s) face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

2.04 FUME HOODS

- A. General Requirements:
 - 1. Comply with SEFA 1.
 - a. Provide fume hoods UL listed and labeled for compliance with UL 1805.
 - 2. Pre-pipe fume hoods for service fittings.
 - 3. Pre-wire fume hoods for light fixtures and receptacles.
 - a. Terminate all wiring in a junction box on top of hood.
- B. Fume Hood:
 - 1. Ventilation: Variable Air Volume (VAV).
 - 2. Configuration: Standing-height; bench mounted, on chemical storage cabinets. Refer to elevations.
 - 3. Nominal Interior Height: 48 inches.
 - 4. Sash Type: Vertical rising.
 - a. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
 - b. Glazing: Laminated safety glass.
 - c. Sash Guides: Corrosion-resistant polyvinyl chloride (PVC) track.
 - d. Vertical Sash mechanism: Designed to prevent sash drop in case of mechanism failure.
 - 1) Cable: Minimum 3/32 inch (2 mm) thick stainless steel of construction standard with the manufacturer.
 - (a) Sprocket system for Sash Chain: Hardened sprockets with one full-width shaft per sash, running in ball-bearings.
 - e. Vertical Sash Pull: Type 316 stainless steel, with No.4 finish.
 - 5. Top Front Panel: Standard integral grille stamped into panel of same materials as fume hood exterior.
 - 6. Exterior: Sheet steel.
 - 7. Interior Lining: Polypropylene.
 - a. Color/Finish: White.
 - 8. Service Fittings and Fixtures:
 - a. As specified in 12 35 53.13 - Metal Laboratory Casework.
 - b. Cup Sink : Drop-in Epoxy, complete with removable stainer and waste fitting, side-mounted at floor-mounted fume hood.
 - 1) Shape: Oval.
 - 2) Size: 3 inches by 9 inches (75 by 228 mm).
 - c. Water Outlet Fitting Assembly: Model _____ manufactured by _____.
 - d. Vacuum-breaker Assembly: Model _____ manufactured by _____.
 - 9. Access Panels: Provide removable panels on both sides hood exterior and interior lining panels.
 - 10. Work Surface:
 - a. Work Top for Fume Hoods Other Than Floor-mounted Type: Epoxy resin.
 - 1) Edge: Raised rim with beveled edges and corners.
- C. Fume Hood Base Cabinets:
 - 1. See Section 12 35 53.13 - Metal Laboratory Casework.
 - 2. Exterior construction: Metal cabinets.
 - 3. Material: Sheet steel.
 - 4. Color/Finish: As indicated on drawings.

- D. Light Fixtures: UL labeled, vaporproof, one-tube, T-5 fluorescent light fixtures. Number and length of fixtures as necessary for fume hood width. Mounted above sealed safety glass panel. White baked-enamel finish on fixture interior.
 - 1. Average Interior Illumination Level: 80 footcandles.

2.05 FABRICATION

- A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations, or as necessary to permit movement through a 35 inches by 79 inches clear door opening.
- B. Steel Exterior: Fabricated from steel sheet, 0.048 inch (18-Gauge) thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Chemical-resistant finish applied to interior and exterior surfaces of component parts before assembly.
- C. Ends: Fabricated with double-wall end panels. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
- D. Lining Assembly: Unless otherwise indicated, assembled with stainless-steel fasteners or epoxy adhesive, concealed where possible. Joints sealed by filling with chemical-resistant sealant during assembly.
 - 1. Lining components fastened together with stainless-steel cleats or angles to form a rigid assembly to which exterior panels are attached.
 - 2. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.
- E. Rear Baffle: Same material as fume hood lining, unless otherwise indicated, at rear of hood with openings at top and bottom, with corrosion-resistant fasteners. Fabricated for removal to facilitate cleaning behind baffle.
 - 1. Preset baffles, unless otherwise indicated.
- F. Exhaust Plenum: Full width of fume hood, sized and configured to provide uniform airflow, of same material as hood lining, and with duct stub for exhaust connection.
 - 1. Duct-Stub Material: Epoxy-coated steel, unless otherwise indicated.
- G. Airfoil: At bottom of fume hood face opening, with _____ inch no gap between bottom of airfoil and work top. Sash to close on top of airfoil. Designed to direct airflow across work.
 - 1. Fabricated from _____ 18-gauge paint steel.
- H. Ceiling Extensions: Filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods, and extending from tops of fume hoods to ceiling. Flange, notch, and reinforce ceiling extensions as required for rigidity. Fabricate to form well-fitting closures, free from oil-canning.
 - 1. Provide bottom-hinged access panels within the front ceiling extension filler panel to facilitate access to light fixture and other fume hood components at top of hood not readily accessible by other means.
- I. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.
- J. Comply with requirements of other sections for factory installation of water and laboratory gas service fittings, piping, electrical devices, and wiring. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated.

2.06 MATERIALS

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- C. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to ASTM E84.
- D. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.
 - 1. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 pounds per square inch.
 - b. Modulus of Elasticity: Not less than 2,000,000 pounds per square inch.
 - c. Hardness (Rockwell M): Not less than 100.
 - d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 degrees F.
 - f. Flame-Spread Index: 25 or less according to ASTM E84.
 - 2. Chemical Resistance: As follows when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect:
 - 1) Acetic acid (98 percent).
 - 2) Acetone.
 - 3) Ammonium hydroxide (28 percent).
 - 4) Benzene.
 - 5) Carbon tetrachloride.
 - 6) Dimethyl formamide.
 - 7) Ethyl acetate.
 - 8) Ethyl alcohol.
 - 9) Ethyl ether.
 - 10) Methyl alcohol.
 - 11) Nitric acid (70 percent).
 - 12) Phenol.
 - 13) Sulfuric acid (60 percent).
 - 14) Toluene.
 - b. Slight Effect:
 - 1) Chromic acid (60 percent).
 - 2) Sodium hydroxide (50 percent).
 - 3. Color: Black.
- E. Polypropylene: Unreinforced polypropylene complying with ASTM D4101, Group 01, Class 1, Grade 2.
- F. Laminated Safety Glass: ASTM C1172.
- G. 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.
- H. Fasteners: Stainless-steel, where exposed to fumes.

2.07 ACCESSORIES

- A. Airflow Monitors/Indicators and Alarms: Provide cut out for each fume hood for an airflow monitor/indicator by Division 23.
 - 1. Source: Laboratory ventilation controls manufacturer.

2. Airflow Monitor/Indicator Functionality:
3. Airflow Alarm functionality: Audible (85 dB @ 4 inch distance), and visual alarm that activates when airflow sensor reading is outside of preset range.
 - a. Reset and test mode.
 - b. Programmable Switch: Designed to silence audible alarm and automatically reset when airflow returns to within preset range. Warning light to stay on when alarm is silenced.
 - c. Capability for integration with BAS (Building Automation System) via BACnet.
- B. Fume Hood Controller: Airflow Indicator/monitor with built-in electronics to control a dedicated exhaust fan and/or exhaust valve.
 1. Controller is part of a control system specified in Section Div 23.
- C. Sash Stops: Spring-loaded stops to limit hood opening to 18 inches height. Manually releasable to open sash fully, and to reset automatically when sash is lowered below set level.

2.08 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory testing of each type of fume hood.
- C. Non-Complying Work: See Section 01 40 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with indicated requirements for installing water and laboratory gas service fittings, and electrical and telecommunications devices.
 1. Install fittings in accordance with shop drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods.

3.03 FIELD QUALITY CONTROL

- A. Field test fume hoods as specified below.
 1. General: Test fume hoods as installed to assess airflow velocity. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.
 2. Preparation:
 - a. Inspect each fume hood to confirm its installation complies with drawings and specifications.

- b. Inspect laboratory space to verify that construction complies with drawings and specified requirements.
 - c. Do not proceed with fume hood testing until an acceptable TAB report has been received.
 - d. Verify that proper temperature and pressurization of the lab space can be maintained, with door(s) to the space in closed and open positions.
 - e. Adjust non-complying physical and control systems until conditions favorable to testing fume hoods are present.
- 3. Operating Conditions Tests:
 - a. Conduct face velocity tests to confirm that target velocities are being achieved within acceptable tolerances.
 - b. Conduct airflow indicator/monitor tests to confirm acceptable variation from corresponding measured value. Calibrate and adjust device to function within specified accuracy parameters.
 - c. Conduct exhaust flow and static pressure tests of the HVAC system and its controls to confirm flow volume and static pressures are within acceptable tolerances.
 - d. In projects with VAV lab ventilation systems, conduct response time and stability tests to confirm how the HVAC supply and exhaust systems respond to different sash opening positions.
 - e. Conduct tests of alarm device by shutting off the fume hood exhaust and verify that the individual fume hood alarm activates and operates in specified manner.
 - f. Conduct tests of individual controls provided at the fume hood (such as unoccupied cycle override, alarm override, etc.) to verify they operate in specified manner.
- 4. Containment Performance Tests:
 - a. Conduct airflow visualization tests (local smoke challenges) to provide a visual indication of fume hood's capture performance.
 - b. Conduct tracer gas containment tests, using mannequins to confirm gas concentrations meet (are below) specified criteria.
 - 1) Use tracer gas agreed-upon with Owner.
- B. Field test installed fume hoods in accordance with requirements of Section 23 05 93.
- C. Reporting Requirements: Comply with Section 5 of NEBB Fume Hood Testing (FHT) Standard, current edition. Organize and include, at a minimum, the following information:
 - 1. Report title.
 - 2. Report certification.
 - 3. Table of contents.
 - 4. Report summary/ remarks.
 - 5. Appropriate forms.
 - 6. Instrument calibration.
 - 7. List of abbreviations used.
 - 8. A room layout drawing for each tested item. Identify: walls; doors; fume hood(s); other present environmental enclosures (e.g. biological safety cabinet(s), laminar flow hood(s), canopy hood(s), etc.); location and airflow pattern of all air supply, return, and exhaust grilles, registers and diffusers.

3.04 ADJUSTING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand only. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

3.05 CLEANING

- A. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.06 DEMONSTRATION

- A. Demonstrate proper operation of fume hoods and their accessories to Owner's designated representative.

3.07 FUME HOOD SCHEDULE

- A. See drawings for Fume Hood Schedule/ requirements.

END OF SECTION

SECTION 12 35 53.13
METAL LABORATORY CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Standard metal laboratory cabinets and cabinet hardware.
- B. Mobile cabinets.
- C. Tables.
- D. Wall shelving.
- E. Adaptable laboratory furniture system.
- F. Service space framing.
- G. Service enclosures.
- H. Acid storage cabinets for below fume hoods.
- I. Solvent storage cabinets for below fume hoods.
- J. Ceiling service panels.
- K. Countertops.
- L. Laboratory sinks.
- M. Pegboards.
- N. Laboratory emergency equipment plumbing fixtures.
- O. Service fittings and outlets.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- C. Section 09 22 16 - Non-Structural Metal Framing: Reinforcements in metal-framed partitions for anchoring casework.
- D. Section 09 65 00 - Resilient Flooring: Resilient wall base.
- E. Section 22 40 00 - Plumbing Fixtures: Non-laboratory sinks.
- F. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Surface raceway systems.

1.03 DEFINITIONS

- A. Adaptable Laboratory Furniture System: Modular furniture assemblies consisting of individual components, including: support structures; cabinets and storage units; worksurfaces; shelving; accessories.
- B. Mobile Cabinet: Free-standing base cabinet storage device mounted on casters or glides.

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- F. ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
- G. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- J. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.
- K. BHMA A156.9 - Cabinet Hardware.
- L. ICC (IFC) - International Fire Code.
- M. MFMA-4 - Metal Framing Standards Publication.
- N. NEMA LD 3 - High-Pressure Decorative Laminates.
- O. NFPA 1 - Fire Code.
- P. NFPA 30 - Flammable and Combustible Liquids Code.
- Q. NFPA 70 - National Electrical Code.
- R. SEFA 1 - Laboratory Fume Hoods.
- S. SEFA 2 - Installations.
- T. SEFA 3 - Laboratory Work Surfaces.
- U. SEFA 7 - Laboratory Fixtures.
- V. SEFA 8M - Laboratory Grade Metal Casework.
- W. SEFA 10 - Adaptable Laboratory Furniture Systems.
- X. SEFA 11 - Liquid Chemical Storage Cabinets.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of casework with related items.
 - 1. Service Fixtures: Coordinate location and characteristics of service connections.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Details of materials, component dimensions and configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware and keying, accessories, and service fittings, if any.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
- D. Samples For Color Selection: Color charts for each different finish material.

- E. Test Reports: Independent laboratory reports showing compliance with chemical and physical resistance requirements for casework finish.
- F. Manufacturer's Installation Instructions.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- J. Finish touch-up kit for each type and color of materials provided.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year warranty against defects. Complete forms in Owner's name and register with manufacturer. Covered defects include, but are not limited to:
 - 1. Ruptured, cracked, or stained finish coating.
 - 2. Discoloration, or lack of finish integrity.
 - 3. Cracking or peeling of finish.
 - 4. Weld or any other structural failure.
 - 5. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Laboratory Casework:
 - 1. Bedcolab Ltd: www.bedcolab.com
 - 2. CiF Lab Solutions LP: www.cifsolutions.com
 - 3. Hamilton Laboratory Solutions: www.hamiltonlab.com
 - 4. Institutional Casework Inc: www.iciscientific.com
 - 5. Kewaunee Scientific Corp: www.kewaunee.com
 - 6. Labcrafters, Inc: www.lab-crafters.com
 - 7. Mott Manufacturing Ltd: www.mott.ca
 - 8. **Air Master Systems Corp.: www.airmastersystems.com**
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Countertops:
 - 1. Trespa (Solid phenolic): www.trespa.com
 - 2. Fundermax (solid phenolic): www.fundermax.us
- C. Sinks and Cup Sinks:

1. Durcon (Epoxy resin, Polyolefin): www.durcon.com
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Water and Gas Service Fittings:
1. Broen-Lab A/S: www.broen-lab.com/#sle.
 2. Chicago Faucets, a Geberit company: www.chicagofaucets.com/#sle.
 3. WaterSaver Faucet Co: www.wsflab.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 METAL LABORATORY CASEWORK

- A. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
1. Style: Flush overlay - square edge.
 2. Steel Sheet Metal:
 - a. Gables, Front and Back Panels, Gusset Plates, Aprons, and Rails: 18 gauge, 0.0478 inch minimum thickness.
 - b. Drawers, Cabinet Floors, Shelves, Filler Panels and Drawer Dividers: 20 gauge, 0.0359 inch minimum thickness.
 - c. Backing Sheet to Door and Door Fronts: 22 gauge, 0.0299 inch minimum thickness.
 3. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7 and SEFA 8M, provide components that safely support the following minimum loads, without deformation or damage:
 - a. Base Units: 500 pounds per linear foot across the cabinet ends.
 - b. Tables: 300 pounds on four legs.
 - c. Shelves: 100 pounds.
 4. Seismic Performance: Casework, including attachments to other work, able to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Component Importance Factor: 1.0.
 5. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
 6. Edges and Seams: Smooth. Form counter tops, shelves, and drain boards from continuous sheets.
 7. Shelf Edges: Turned down 3/4 inch on each side and returned 3/4 inch front and back.
 8. Ends: Close open ends with matching construction.
 9. Welding: Electric spot welded; joints ground smooth and flush.
 10. Drawers and Doors: Fabricate drawer and door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware.
 - a. Fill with sound-deadening core.
 11. Shelves: Adjustable and fixed shelves formed down 3/4 inch, returned back 7/8 inch, and up 1/4 inch into a channel shape, front and rear; formed down 3/4 inch at each end. Shelves over 42 inches long reinforced with a channel welded to underside of shelf.
 12. Fittings and Fixture Locations: Cut and drill countertops, backs, and other casework components for service outlets and fixtures.
 13. Removable back panels on indicated base cabinets. Partial height back panels at sink cabinets.
 14. Fixed panels at backs of open spaces between base cabinets and at ends of utility spaces not otherwise enclosed.
 - a. Cutouts for power receptacles where indicated on drawings.
 15. Scribe Panels: Similar to filler panels, except flanges on one side and flat on the other, of matching construction and finish.

16. Stainless Steel Finish: No.4, brushed finish.
17. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials, and to separate dissimilar metals.
- B. Mobile Cabinets: Same construction as fixed base cabinets, with modifications.
 1. Toe kick space eliminated.
 - a. Cabinet underside reinforced with 14 gauge, 0.0747 inch minimum steel channels to provide caster mounting points.
 - b. Four casters, each with a load rating of 165 pounds.
 2. For cabinets with drawers, include a counterweight to prevent the cabinet from tipping when one drawer is opened.
 - a. Drawers rated at 50 pounds, maximum.
- C. Acid Storage Cabinets: Construction identical to other cabinets, with following exceptions:
 1. Completely lined with corrosion-resistant liner material; stainless steel fasteners for all connections and hardware inside cabinet.
 2. Shelves: Perforated or vented, rigid polypropylene.
 3. Bottom Pan: Liquid tight, polypropylene liner covering entire bottom of acid storage cabinet.
 4. Vents: Comply with SEFA 1.
 - a. Locate acid storage cabinet vents in accordance with manufacturer's instructions.
 - b. Vent base cabinets through work surface with manufacturer's vent kit.
 - c. Vent each acid storage cabinet separately.
 - d. When acid storage cabinets are installed below fume hoods, provide louvered cabinet doors.
 - e. Seal penetrations with chemical resistant sealant.
- D. Solvent (Flammable and Combustible Liquids) Storage Cabinets: Construction identical to other cabinets, with following exceptions:
 1. Construct to NFPA 30 and applicable OSHA requirements.
 2. Comply with SEFA 11.
 3. Fire Resistance: Maximum internal temperature of 325 degrees F at the center, and 1 inch from top of the cabinet when cabinet is subjected to a ten minute fire test that simulates fire exposure of a standard time-temperature curve specified in ASTM E119.
 4. Steel sheet, 18 gauge, 0.0478 inch minimum thickness, double panel construction with 1-1/2 inch space between panels and electrical grounding connection.
 5. Shelves: Full depth, adjustable sloped metal shelf.
 6. Bottom Pan: 2 inches deep liquid-tight pan covering entire bottom of cabinet.
 7. Cabinet Hardware: UL-listed.
 - a. Hinges: Full-length stainless steel continuous (piano) hinges.
 - b. Self-closing Doors: Comply with requirements of NFPA 1 and ICC (IFC). Minimum 90 degree opening. Three-point latch arrangement, door(s) shutting and latching automatically when hold-open device's fusible link melts at 165 degrees F under fire conditions outside the cabinet. At pair of doors, synchronize latching so that both doors always fully close.
 - c. Door Handles: Manufacturer's standard, with slip-resistant grip.
 - 1) Provide manufacturer's standard cylinder lock and key set.
 - d. Grounding screw-lug.
 8. Vents: Provide venting capable of achieving at least ten air changes per hour.
 - a. Tie into building hazardous exhaust system.
 - b. Vent Connections: 1-1/2 inch minimum diameter, corrosion resistant piping having flame spread index of 25 or less, when tested in accordance with ASTM E84.

- c. Provide minimum of two vents with fire arrestors for each cabinet.
- 9. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.
- E. Tables: Include fixed and adjustable height units.
 - 1. Fixed Height Table Construction: Manufacturer's standard, with manufacturer's standard material countertops, unless noted otherwise.
 - a. Formed metal skirting panels welded into a rigid frame. Corners notched and reinforced to receive manufacturer's standard square metal tubular legs, bolted securely in place.
 - b. Table Bracing: Removable tube members, in size standard with the manufacturer, installed between legs in manufacturer's standard configuration. Removable bracing designed to be mechanically fixed to concealed U-shaped mounting tabs that are integral with each leg.
 - c. 3/8 inch leveling devices.
 - d. Slip-on type black PVC shoes.
 - e. Mobile tables constructed the same as standard laboratory tables, except with table legs designed to receive swivel casters.
 - 1) Caster wheels of nonmarring type urethane tires in gray or black color.
 - 2. Adjustable Height Table Construction: Manufacturer's standard, with countertop worksurfaces, unless noted otherwise.
 - a. Cantilevered Base Frame: Each base equipped with a pair of glides.
 - b. Worksurface Support Frame: Telescoping from base frame.
 - c. Worksurface: Phenolic Resin.
- F. Wall Shelving: At locations indicated.
 - 1. Adjustable Shelf Supports: Standard back-mounted system using single-slotted surface mounted metal shelf standards, in lengths indicated, with coordinated cantilevered shelf brackets, painted to match shelving finish, designed for nominal 1 inch spacing adjustments.
 - 2. Metal Shelves: steel shelves in lengths indicated.
 - a. Depth: 12 inches.
- G. Apron Assemblies: Construction similar to other cabinets, fabricated from metal channel-shaped skirting panels.
 - 1. Assemblies consisting of front and back panels, with drawer suspension framing mechanically fastened to support channels. Weld support channels to skirting panels to form a riding one-piece frame.
- H. Countertop Panel-Type Supports: Materials similar to adjacent casework, 1-1/2 inch in width, with front-to-back and toe space dimensions matching base cabinet. Designed to be secured in a concealed fashion to countertop material. Include two leveling devices per support panel.
- I. Vertical Service Drop Enclosures: Where indicated on drawings, for service drops to metal casework.
 - 1. Frames: Unless otherwise standard with the manufacturer, channel strut frames, with members at all corners, bottom, mid-height, and top of enclosure. Designed for anchorages at the bottom to countertop, and at top to miscellaneous metal support framing.
 - 2. Enclosures: Consisting of fixed and removable (access) panels, in configuration standard with the manufacturer.
 - a. Extent: Up to underside of ceiling.
 - b. Rear Panel: Fixed panel, constructed like other casework closure panels.

- c. Side Panels: Fixed panels, constructed like other casework closure panels.
- d. Front Panels:
 - 1) Fixed Panel: Metal panel, constructed like other casework closure panels.
 - 2) Removable (Access) Panel: Metal panel, constructed like other casework closure panels.
- e. Attachment: Use corrosion-resistant metal mounting hardware and fasteners.
- J. Ceiling Service Panels: Designed to integrate into acoustical panel suspension grids for delivering multiple plumbing, electrical and data services.
 - 1. Fabricated to fit in standard 24 inches by 48 inches ceiling grids.
 - 2. Enclosure Material: 18 gauge sheet steel with chemical-resistant finish specified herein.
 - 3. Required Fitting Types: Quick-connect fittings and hoses.
 - 4. Service Panel Types: Pre-punched panels accepting groups of services.
 - a. Four-Station, 24 inches by 24 inches panel: Refer to details on drawings for services required.
 - 5. Quick-Connect Fittings: Male and female types, suitable for service connected, 3/8 inch NPS.
 - a. Provide in up to eight different sizes (keys) to prevent connecting to wrong service.
 - 6. Accessories:
 - a. Service Hoses.
 - b. Power Cords.
 - 1) Single-circuit, 3-wire, 20 AMP/120 VAC, 72 inches long, with Twist-Lock plugs.

2.03 ADAPTABLE LABORATORY FURNITURE SYSTEM

- A. General: Modular component system incorporating and/or accommodating compatible metal laboratory casework items, including: cabinets, countertop frames, ledges and supporting structures.
- B. Basis of Design: Kewaunee, Enterprise System
- C. Comply with SEFA 10.
- D. SEFA System Classification: Class 4 - Core based.
- E. Structural Modules: Primary support structures for adjustable work surfaces, shelving, utility delivery systems, and casework. Slotted channel design to provide support for components on 1 inch vertical increments.
 - 1. Module Length(s): 60 inches and As indicated on drawings.
 - 2. Module Height(s): 84 inches.
 - 3. Anchors and Brackets: For each structural support island, peninsula, and corner module; providing specified load-bearing capacity for the module, and resulting in a rigid, non-racking system. Height of module to permit anchorage to supplementary structural bracing above ceiling.
 - a. At Bottom (Floor-mounted Modules): Floor mounting brackets complete with leveling bolts and mounting holes, standard with the system manufacturer.
 - b. At Bottom (Countertop- or Ledge-mounted Modules): Mounting brackets or clip angles standard with the system manufacturer.
 - c. At Top: Mounting brackets or clip angles standard with the system manufacturer.
- F. Facing Panels: End and insert closure panels at locations indicated on drawings.
 - 1. Modular units, with tight fit to other system components. Panels to be removable and replaceable without use of special tools.
 - 2. Unless otherwise indicated, facing closure panels of the following types:
- G. Worksurface Frames and Countertops:

1. Core-based Frames: Shaped to allow cantilevering from structural modules and capable of supporting the weights of the countertop, suspended base cabinets, and imposed loads.
 - a. Frame Length(s): 60 inches or as indicated on the drawings.
 - b. Total Supportable Load: 600 pounds, maximum, per frame.
 - c. Provide channels for suspension of base cabinets at any point along their length.
2. Countertops: Include type(s) specified below.
 - a. Material: Countertops made from epoxy resin.
 - b. Cantilevered Countertop Front-to-back Dimension: 24 inches.
- H. Shelving: Modular units with integral brackets formed from metal sheets, with additional stiffener/reinforcing for units over 48 inch long.
 1. Typical Cantilevered Shelf Depth: 12 inches.
 2. 1" back lip and stainless steel rod on front for lower two shelves.
- I. Finishes:
 1. Metal components: Same as other casework specified in this section.

2.04 CABINET HARDWARE

- A. Manufacturer's standard styles, and as indicated below.
- B. Finish of exposed stainless steel components: No.4 finish.
- C. Shelves in Cabinets:
 1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- D. Drawers:
 1. Pulls: Stainless steel wire pulls, 4 inches wide.
 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.05 COUNTERTOPS

- A. Countertops:
 1. Types: More than one type is required, as specified below. See drawings for location of each type of countertop.
 2. Chemical resistant high pressure decorative laminate sheet bonded to substrate (Phenolic Resin).
 - a. Laminate Sheet: NEMA LD 3 Grade HGL, 0.039 inch nominal thickness.
 - b. Finish: Matte or suede, gloss rating of 5 to 20.
 - c. Surface Color and Pattern: As selected by Architect from manufacturer's full line.
 - d. Back and End Splashes: Same material, same construction; minimum 4 inches high.
 - e. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.

2.06 SINKS

- A. Laboratory sinks.
 1. General: Sinks with perimeter lip for drop-in installation.
 2. Cup Sink: Epoxy, with waste fitting.
 - a. Shape: Oval.
 - b. Size: 3 inches by 9 inches (75 by 228 mm).
- B. Non-laboratory sinks are identified on drawings and are specified in Section 22 40 00.

2.07 PEGBOARDS

- A. Stainless steel pegboards with pre-drilled or punched holes in a staggered pattern, designed to accept removable white polypropylene pegs. With each pegboard include a stainless steel drip-trough with drain outlet and matching diameter 36 inch long PVC drain hose.
 - 1. Size: 30 inches wide by 30 inches high, unless noted otherwise on the drawings.

2.08 LABORATORY EMERGENCY EQUIPMENT PLUMBING FIXTURES

- A. General: Provide emergency equipment products complying with requirements of ANSI Z358.1.
- B. Eyewash/Drench Hose Units: Deck-mounted, dual-purpose units. Designed for use as a fixed eyewash when unit is left in deck flange, and as a drench hose when removed from deck flange. Refer to fixture schedule on drawings.
- C. Eye/Face Wash Units: Deck-mounted units.
 - 1. Refer to fixture schedule on drawings.
 - 2. Type ____: 90-Degree swing-down, designed for mounting behind the sink.
 - 3. Sign: Manufacturer's standard ANSI-compliant identification sign.
 - 4. Manufacturers:
 - a. Broan.
 - b. Watersaver.
 - c. Chicago Faucet.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Safety Shower Units: Recessed into wall construction.
- E. Eyewash/Safety Shower Combination Units: Recessed into wall construction. Refer to fixture schedule on drawings.

2.09 SERVICE FITTINGS

- A. General: Comply with requirements of SEFA 7.
- B. Gas Service Fittings and Fixtures. Refer to fixture schedule on drawings.
 - 1. Laboratory Gas Fitting :Refer to fixture schedule on drawings.
- C. Water Service Fittings and Fixtures.
 - 1. Water Fitting :Refer to fixture schedule on drawings.
 - 2. Pure Water Fitting :Refer to fixture schedule on drawings.
 - 3. Water, Single Faucet :Refer to fixture schedule on drawings.
- D. Electrical Fittings and Fixtures:
 - 1. Electrical Fittings, General: Types indicated, for mounting on laboratory casework, including, as appropriate, grounding screws, and mounting accessories and fasteners.
 - 2. See Section 26 05 33.23 for surface raceway systems.

2.10 SERVICE SPACE FRAMING

- A. Support Framing Units: Galvanized steel framing units at space between back-to-back cabinets and between backs of cabinets and wall surfaces:
 - 1. Manufacturer's standard assemblies.
 - 2. Framing units consisting of two steel slotted channels complying with MFMA-4 that are connected at top and bottom by U-shaped brackets made from steel flat bars.

2.11 MATERIALS

- A. Sheet Steel: High-strength low-alloy, cold rolled and leveled unfinished steel sheet, ASTM A1008/A1008M, Class 1 (matte) finish.

- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Phenolic Panels: Monolithic core of phenolic resin reinforced with cellulose fibers and manufactured under high pressure and at high temperatures, with melamine-impregnated decorative surface papers; NEMA LD 3 Compact Laminate, Grade CGS.
- D. Solvent-Resistant Liner Material: High density, asbestos free, non-combustible, calcium-silicate-based panel consisting of autoclaved Portland cement, mineral fillers and synthetic fibers.
- E. Solvent-Resistant Liner Material: Polypropylene.

2.12 FINISHES

- A. Sheet Steel Finish: Having chemical resistance equal to Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8M. Test applied finishes using procedures specified in ASTM D522/D522M.
 - 1. Coating Type, New Casework: Baked on epoxy; minimum two coats.
 - 2. Color: As selected from manufacturer's standard selection.
 - 3. Preparation: Degrease and phosphate etch, and prime.

2.13 ACCESSORIES

- A. Gas Cylinder Brackets: Restraint safety assemblies for laboratory gas cylinders. Refer to details on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure, with no distortion.
 - 1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Faces of Cabinets from a True Plane: 1/16 inch in 10 feet.
 - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- F. Secure upper and floor cabinets to concealed reinforcement at gypsum board assemblies.
- G. Separate dissimilar metals to prevent galvanic action.
- H. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush,

tight, and uniform.

- I. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- J. Vented Cabinets: Install in strict compliance with manufacturer's written installation instructions.
 - 1. Install vent kits and connect to exhaust system.
 - 2. Use only rigid materials for venting. No flexible materials permitted.
- K. Replace units that are damaged, including those that have damaged finishes.

3.02 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.03 CLEANING

- A. Clean casework and other installed surfaces thoroughly.

3.04 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.
- C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

This page intentionally left blank

SECTION 26 05 33.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface raceway systems.
- B. Wireways.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Receptacles.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NFPA 70 - National Electrical Code.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway.
- E. UL 5 - Surface Metal Raceways and Fittings.
- F. UL 5A - Nonmetallic Surface Raceways and Fittings.
- G. UL 111 - Outline of Investigation for Multioutlet Assemblies.
- H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate rough-in locations of outlet boxes provided under Section 26 05 33.16 and conduit provided under Section 26 05 33.13 as required for installation of raceways provided under this section.
 - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install raceways until final surface finishes and painting are complete.
 - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

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

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
 - 1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- C. Shop Drawings:
 - 1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
 - 1. Legrand North America, Inc; Wiremold: www.legrand.us/#sle.
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.
- D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.
- E. Type Wiremold AL3300 - Surface Raceway System:
 - 1. Raceway Type: Single channel, anodized aluminum.
 - 2. Length: As indicated on the drawings.
 - 3. Integrated Device Provisions:
 - a. Receptacles:
 - 1) Comply with Section 26 27 26, except for finishes.
 - 2) Configuration: As indicated on the drawings.
 - 3) Spacing: As indicated on the drawings.
- F. Type Wiremold 5400 - Surface Raceway System:
 - 1. Raceway Type: Two channel, nonmetallic.
 - 2. Length: As indicated on the drawings.
 - 3. Integrated Device Provisions:
 - a. Receptacles:
 - 1) Comply with Section 26 27 26, except for finishes.
 - 2) Configuration: As indicated on the drawings.
 - 3) Spacing: As indicated on the drawings.
 - b. Communications Outlets:
 - 1) Voice and Data Jacks: As specified in Section 27 10 00.

- 2) Configuration: 45° angled jacks .

2.03 WIREWAYS

- A. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- B. Wireway Type, Unless Otherwise Indicated:
 - 1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
- C. Finish for Painted Steel Wireways: Painted to match wall color unless otherwise indicated.
- D. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.04 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install raceways plumb and level.
- D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 26 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Identify raceways in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect raceways for damage and defects.
- C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.
- D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

DIVISION 27
COMMUNICATIONS

27.00.01 COMMUNICATIONS

v.05012019

SCOPE OF WORK

1. This specification covers the furnishing and installation of materials for telecommunications system structured cabling, complete and in operating condition as indicated on drawings and/or as described herein, applicable to new building construction projects and major renovations on all Indiana University campuses. For smaller renovations, exceptions *may* be required, but only if approved by the appropriate UITs representative on a case-by-case basis. Potential exceptions are noted in this document and in the UITs document "IU Building Telecommunications Design Guidelines".

1.1. The telecommunication systems herein specified provides for Information outlets and other low voltage signaling functions (such as for energy management and security systems) through twisted pair, fiber optic, and coaxial cable.

1.2. The system shall provide acceptable outlets for any telecommunication device, which requires connection to other devices, networks or information services serving general university needs.

2. Products shall be as listed in this document or as directed by the Owner.

3. Installation procedures shall be in accordance with industry acceptable practices, product manufacturer's recommendations, federal, state and local codes and standards, and shall include demolition and removal of materials as required to support the work.

4. This section includes tools, materials, equipment and labor necessary to complete a turnkey installation, including but not limited to the following items, which will be supplied by contractor unless otherwise noted by the University:

- 4.1. Cable trays, hangers, and mounting hardware
- 4.2. Conduit
- 4.3. Connecting blocks
- 4.4. Cross connect cable
- 4.5. Cross connect rings or spools
- 4.6. Equipment racks, mounting hardware and wire management
- 4.7. Labels for cables and receptacles
- 4.8. Modular station receptacles
- 4.9. Mounting brackets
- 4.10. Fire Retardant plywood (preferred) or Fire Retardant Painted backboards
- 4.11. Riser cable
- 4.12. Station blocks
- 4.13. Station cables
- 4.14. Velcro Tie wraps, bushings, and miscellaneous

27.01.00 OPERATION AND MAINTENANCE

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072
 Chemistry Addition - Research Labs Renovation
 Bloomington, Indiana
 IU Project No. 20240397 / BSA Project No. 00360477

As a project nears Substantial Completion, telecommunications services must be ordered in a timely manner by the appropriate Indiana University representatives authorized to charge to the appropriate University accounts. The following is a representation of an average schedule for new construction on the Bloomington campus, to be adjusted as needed for individual projects. Other campuses should create a similar schedule that reflects their individual processes and contacts.

EXAMPLE: BLOOMINGTON CAMPUS - Telecom Service Orders Schedule				
ORDERS & SERVICE ACTIVATION	WHO	TO	LEAD TIME	* Cable test results are required before circuits will be activated NEEDED *
Provide updated port counts	Tel Consultant	UITS Construct Rep	6 weeks	before Substantial Completion
Analog (Voice) Line Activations	User	telecom.iu.edu/services	4 weeks	User specified date(s), Jack IDs, Test Results
Elevator Phone Voice Line(s)	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before State Inspection, Jack ID(s), Test Results
Fire Alarm Voice Line(2)	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before State Inspection, Jack ID(s), Test Results
** Network switching equipment will NOT be installed until IDFs are secured				
Telecom Room Locks & Cores	IU Construct Mgr	Facility Operations Lock Shop	1 week	before turnover of IDFs to UITS **
User Data Line Activations	IU Construct Mgr	telecom.iu.edu/services	3 weeks	User specified date(s), Jack IDs, Test Results
Emergency Phones Voice	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before Building Occupancy
Emergency Phone Data/Camera	IU Construct Mgr	telecom.iu.edu/services	3 weeks	before Building Occupancy
Data based V-LAN Data Circuits, including:	IU Construct Mgr	phypltbl@indiana.edu who will contact bms-uiso@iu.edu	3 weeks	before needed, Jack ID(s), Test Results
MDF and IDF Door Control				
Lighting Control Circuits				
Fire Alarm Circuit				
Climate Controls				
Security Cameras				
Card Readers				
(for each, specify if a Static IP is required)				

27.02.00 REFERENCES

27.02.10 APPLICABLE CODES and STANDARDS

Telecommunication design shall comply with Federal and State codes, regulations, and standards with variances adopted as standards by Indiana University and the State of Indiana. Applicable state and national standards include the latest editions of:

1. ANSI/NFPA 70 National Electrical Code with Indiana Amendments, latest edition
2. BICSI CO-OSP Customer Owned Outside Plant Manual
3. BICSI Telecommunications Distribution Methods Manual
4. BICSI Customer Owned Outside Plant Design Reference Manual
5. TIA Standard TIA-230 Color Marking of Thermoplastic Wire
6. FCC Rules and Regulations
7. Indiana Administrative Code, Title 675, Article 22, Indiana Fire Prevention Codes
8. Joint Commission Accreditation of Hospitals Code
9. J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
10. UL 467 Standard for Grounding and Bonding Equipment

11. National Electrical Code
12. National Electrical Safety Code
13. NFPA 101: Life Safety Code
14. RUS Standards for Engineering, Construction, and Installation
15. TIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
16. TIA 526-14 Optical Power Loss Measurements for Installed Multimode Fiber Cable Plant – OFSTP-7
17. TIA 568 Commercial Building Telecommunications Cabling
18. TIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces
19. TIA 598 Optical Fiber Cable Color Coding
20. TIA Standard ANSI/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
21. TIA 604 Standards on Fiber Optic Connector Intermateability
22. TIA 606 Administration Standard for Commercial Telecommunications Infrastructure
23. TIA 758 Customer Owned Outside Plant Telecommunications Cabling Standard
24. TIA Telecommunication Systems Bulletin TSB67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
25. TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
26. The "IU Building Telecommunications Design Guidelines" is part of the Division 27 specification

27.03.00 DEFINITIONS

1. **OUTSIDE PLANT:** Transmission facilities used in the distribution of voice, data, or video from point where it leaves one building and enters another, including copper, coax, fiber optics, and microwave.
2. **ENTRANCE CABLE:** The outside plant cable(s) that enter the building from the campus outside plant communication distribution network.
3. **ENTRANCE FACILITY (telecommunications):** An entrance to a building for both public and private network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.
4. **BACKBONE:** A facility (e.g. pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
5. **BACKBONE CABLE (Riser Cable):** Cabling from the Building Telecommunication Equipment Room (see below) to each Floor Telecommunication Equipment Room (see below), including copper, coax, and fiber optics cabling.
6. **MAIN BUILDING TELECOMMUNICATION EQUIPMENT ROOM (IDF-1/Building MDF):** The main telecommunication room located where the university outside plant cabling and university backbone cabling (risers) are interconnected; in other words, the Entrance Facility for university network cabling.
 - 6.1. This room may also serve as a telecommunication equipment room (IDF-2, see below).
 - 6.2. For new construction and major renovations, the telecommunications equipment rooms shall not house systems other than telecom systems. Excluded systems include:
 - 6.2.1. non UITS servers
 - 6.2.2. security system monitors
 - 6.2.3. fire alarm monitors

6.2.4. building IP camera monitoring systems

6.2.5. audio systems

6.2.6. mechanical systems conduit and components

6.2.7. plumbing systems pipe, conduit and components

6.2.8. HVAC ducting and components

6.2.9. electrical equipment

6.2.10. door controller equipment other than that for IDF rooms

6.2.11. or any other systems requiring access by non-UIITS personnel.

6.3. For smaller renovations, refer to "27.04.50 GENERAL INSTALLATION" section, to the Appendix "IU Building Telecommunications Design Guidelines", and special instructions provided in the specifications and plans.

7. TELECOMMUNICATION EQUIPMENT ROOM (IDF-2): A centralized space where telecommunications network equipment connects to backbone cable and station horizontal cabling.

7.1. Telecommunication equipment rooms are normally provided a minimum of one per floor of a building.

7.2. Floor equipment rooms must be located such that the cable length of any horizontal cable run shall not exceed 295 feet, wire length, termination to termination, and thus may require more than one telecommunication equipment room per floor.

7.3. See also requirements listed under Item 6 (MDF) above.

8. STATION OUTLET BOX: The standard outlet box for telecommunications terminations shall be a double gang 5"x5"x2-7/8" minimum depth box, with mud ring sizes as required.

9. INFORMATION OUTLET: An assembly of interface ports for copper (data), coaxial (campus television), and fiber terminations (data); variations of arrangements are describe elsewhere in this document.

10. GROUNDING: See 27.05.26

27.04.00 EXECUTION

27.04.10 QUALITY ASSURANCE

1. Contractor's management team shall have demonstrated compliance with all applicable Indiana University UIITS installation requirements as a prime contractor or subcontractor on no less than three (3) Indiana University projects.

1.1. The Contractor bears the burden of installing the telecommunications infrastructure described in the University specifications in such a manner that the final product is fully usable in the manner for which it is intended; that an installation merely meets the letter of the specifications is neither sufficient nor acceptable.

1.2. The telecommunications contractor/subcontractor must be capable to and must perform all work on the telecommunications systems for which they are responsible, including testing and corrections, but excluding pathways which fall under the responsibilities of a separate electrical contractor/subcontractor.

1.2. The University may, at its discretion, require the names, previous project list, and references for the Contractor's management team and field personnel assigned to this project prior to the start of the work.

1.3. The University maintains the right to ask for replacement of management or field staff at any time during the project.

2. All cabling shall meet ANSI/TIA-568.

3. Termination and testing of the telecommunication cabling shall be performed by a certified BICSI ITS Installer

2 Optical Fiber or ITS Technicians. It is required for technicians to be BICSI certified and have experience with Category 6 (e or A as applicable) installation.

3.1. At the initial award of this contract and onsite during construction and installation, at least one technician

must be an ITS Installer 2 Optical Fiber and or ITS Technician.

3.1.1. Prior to final award of apparent low bidder, first and last name of certified personnel with appropriate certificates will be required as documentation.

3.1.2. Contractor shall provide certified personnel for the duration of the project, if substitution is required, the appropriate certificates shall be supplied.

3.2. All work shall follow NEC 2011, TIA Standards and follow BICSI installation practices.

3.2.1. Short cuts to any BICSI installation practices or NEC requirements will not be accepted unless previously authorized by a designated University representative in writing and shall be reworked at the contractor's expense.

3.2.2. This will include installing racks, overhead runway, patch panels, horizontal cable, fiber cable, grounding, termination blocks, and removal of dead and abandoned cabling and equipment. The cabling will include horizontal voice and data, thick net, thin net, coax, IBM cabling, fiber and any other dead or abandoned cables within the work area.

3.3. The contractor shall employ on onsite Building Industry Consulting Service International (BICSI) certified project manager for the telecom work.

3.4. Vendors and contractors shall employ a BICSI Registered Communications Distribution Designer (RCDD).

3.4.1. The Vendor shall provide the name and stamp number of the RCDD assigned to this project to the appropriate UITS representative.

3.4.2. The RCDD shall approve construction design and upon completion of installation, certify compliance with the standards and installation practices as specified by this document.

4. Prior to commencing the work of this section, the telecommunication contractor shall convene a meeting with Construction Manager, University Information Technology Services representative, and the consulting design engineer's representative.

4.1. The meeting will cover Project Specifications, Addendum, Change orders, IDF layouts, labeling, and other project work, documents and site conditions.

4.2. System testing procedures and requirements shall be confirmed at this time.

4.3. Test report forms and schedules shall be provided for University review.

4.4. Inspection milestones will be set and notifications scheduled.

4.5. Meeting minutes will be distributed and will include agreements, action items and responsible party(s), for this meeting and for future meetings when required.

5. Store materials and equipment in dry, environmentally controlled space. Do not install equipment and materials until spaces are enclosed, watertight, and dry. Protect equipment from dust and other airborne materials.

6. Contractor's regular job progress meetings with the Construction Manager and other university representatives shall include a University Information Technology Services telecommunications representative.

7. The Contractor shall perform all work according to University plans and specifications, manufacturers' specifications where given, and according to best industry practices otherwise.

8. University *Inspection*: Indiana University will provide advising as requested.

- 8.1. The Office of University Information Technology Services *may inspect* the job as it progresses.
- 8.2. Prior to final acceptance of the work, the Contractor (electrical/telecom) shall make arrangements with the appropriate authorized University personnel to *inspect* the construction areas, both to ensure satisfactory completion of the work and to ensure complete cleanup and restoration of areas affected by the work.
- 8.3. Temporary protection, coverings, and structures must be removed at or before time of *inspection*.
- 8.4. Examine areas and conditions with the Installer present for compliance with requirements and other conditions affecting the performance of telecommunication transmission media.
- 8.5. Areas such as ceilings, which will be enclosed permanently (ie, drywall) or accessible (ie, lay-in ceilings), and which contain telecommunications cabling, must be inspected by the appropriate University UITs representative before enclosure; if not, enclosing materials will be removed and replaced for inspection at no extra cost to the University.
- 8.6. Do not proceed with work until unsatisfactory conditions are corrected in a manner acceptable to the appropriate University personnel.

27.04.20 SUBMITTALS

- 1. Submit shop drawings and/or manufacturer's product data for telecommunications equipment, including termination equipment, copper cables, fiber optic cables, cable routing devices, and associated equipment and materials.
 - 1.1. Include cut sheets with rated capacities, operating characteristics, electrical characteristics and other measurements and descriptions that describe these items in detail.
- 2. Submit manufacturer's test reports and test data for each of the fiber optic cables installed.
 - 2.1. The test reports must clearly identify which fiber corresponds with the respective test measurement data so that the results can be verified prior to installation of the cable.
- 3. Submit a schedule of material and an installation schedule based on the construction schedule and construction phasing, to the Architect/Engineer, within three (3) weeks after contract award.
- 4. Submit qualifications data for material installers, supervisors, and the project RCDD (Registered Communications Distribution Designer).
- 5. Submit completed cable records, including floor plans, riser diagrams, manhole diagrams, footages on any cable other than horizontal cabling, and jack id's by location.
- 6. Submit test reports to the Owner's Representative for approval.
 - 6.1. Include in the test reports the test data taken and converted values.
 - 6.2. Prior to submittal for approval, have test reports signed by authorized witnesses present at tests.
 - 6.3. Submit electronic final copies of approved test reports in tester native format to the Owner's representative.
 - 6.4. No telecommunications services will be provided until verified reports are submitted, reviewed, and found to be acceptable by the appropriate University Information Telecommunication Services (UITs) representative.

27.04.30 DELIVERY, STORAGE and HANDLING

- 1. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified wire and cable reels.

2. Store wire and cable in clean dry space in original containers, following manufacturer's storage guidelines. Protect products from weather, damaging fumes, construction debris and traffic.

3. Handle wire and cable carefully to avoid abrading, puncturing, kinking, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

27.04.40 SEQUENCING and SCHEDULING

1. Coordinate installation of wires/cables with installation of electrical boxes and fittings, cable trays, and raceways.

2. Sequence installation of optical-fiber cabling systems with other work to minimize possibility of damage during construction.

3. Interruptions to existing voice, data and video systems should be avoided where at all possible.

3.1. If it becomes necessary to interrupt voice and/or data network services, then such interruptions must be approved by and scheduled with UITS Change Management.

3.2. Approval is gained by submitting an MOP (Method of Procedure) to the UITS project contact person, containing the following information:

3.2.1. Detailed account(s) of the work to be performed

3.2.2. Proposed outage time(s)

3.2.3. Estimated service restoral time(s)

3.2.4. A contingency plan in case the work takes longer than anticipated, or doesn't go as scheduled.

3.3. Change Management meetings are held on Wednesday of each week

3.3.1. The MOP should be submitted to the UITS project contact person no later than 4:00 pm on the Tuesday of the week in which the work is to be performed.

3.3.2. Outages and associated work should be performed outside of peak hours, such as on weekends, or after 5:00 pm and before 7:00 am during the week.

3.3.3. Actual time(s) first should be approved by the parties affected by the outage(s).

3.3.4. No outages may be scheduled during the first two weeks of a fall or spring semester, during which time there is a "Change Freeze" period.

3.4. Approval from UITS Change Management must be granted before any scheduled outages can be performed.

3.4.1. If the outage is disapproved, then an updated MOP will need to be resubmitted on the following Tuesday, to be reviewed the following day.

3.5. Contractors are solely responsible for:

3.5.1. making all necessary access arrangements in ample time before the work begins.

3.5.2. notifying the affected parties of the scheduled outage(s).

3.5.3. notifying repair@indiana.edu

3.6. Interruptions to video systems should be coordinated with the IU Building Systems division at http://www.indiana.edu/~phyplant/building_systems.html and reported to repair@indiana.edu.

4. When new IDF's are constructed as part of the project, communications work must be completed, tested

and accepted four (4) weeks in advance of the substantial completion date, to ensure that necessary communications circuits will be available for required building systems such as elevator phones, environmental systems monitoring and security systems.

4.1. This includes all IDF associated electrical, HVAC, and door lock systems, as well as riser and outside plant copper and fiber cables, as necessary to allow the permanent installation of voice grade circuits and data network equipment.

27.04.50 GENERAL INSTALLATION

1. In new construction and major renovations, telecom rooms must be clear of mechanicals such as ventilation ducts, water, sewer, or steam pipes, and high voltage electric.

1.1. In smaller renovations and older construction, where it is not possible to remove any or all of these systems, work should be coordinated with the University Architect's Office in order to meet all requirements necessary to ensure safety, security, and proper network system operation.

2. No cable shall be installed in any facilities other than those intended for that use.

2.1. Gas pipe and water pipes must not be used for conduit under any circumstances.

3. Install telecommunication transmission media as indicated, in accordance with manufacturer's written instructions, in compliance with applicable requirements of NEC, and in accordance with recognized industry practices.

4. CMP (Plenum) type cable will be used for all telecommunications cables.

5. Coordinate transmission media installation work, as necessary to properly interface installation of media with other work.

6. Do not install compressed, kinked, scored, deformed or abraded cable, or allow such damage to occur.

6.1. Damaged materials shall be removed from the job site immediately.

7. Use extreme care in handling, fishing, and pulling-in transmission media to avoid damage to conductors, shielding and jacketing/cladding.

7.1. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips, which will not damage media or raceway.

7.2. If power equipment is used to pull cable, the pull speed must not exceed 30 meters per minute.

7.3. Use water based lubricant approved by the cable manufacturer to ensure manufacturer's pulling tensions are not exceeded.

7.3.1. Compound used must not deteriorate conductor or insulation.

7.4. Cable bending radii must not be exceeded.

7.5. Pulling methods must not cause cable to twist.

7.6. Cables pulled through pull boxes shall be hand assisted to prevent the cable from being crushed, kinked, or scraped.

8. Provide pull strings in telecommunication conduit.

8.1 To facilitate future cable installations, install a nylon pull cord in each conduit simultaneously with the pull-in of cable.

9. Pull conductors simultaneously where more than one is being installed in same raceway.

10. Splices in building media runs are NOT permitted.

10.1. Building wiring must be continuous and undamaged from outlet to connecting block or connecting block to connecting block.

11. Terminations shall be made with the manufacturer's stated tools and in accordance with manufacturer's instructions and guidelines.

12. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque specified in UL Std.

13. When necessary within IDFs, horizontal Station cables shall be secured with Velcro tie wraps. Outside Fiber and Copper Entrance shall be secured with standard tie wraps. Observe the manufacturer's recommendations for distances between tie wraps and tightening tension from tie wraps and as specified in

ANSI/TIA-568.

13.1. Outside of IDFs, horizontal cabling, entrance cables, and riser cables must be installed within industry standard pathways, such as cable tray, J hooks, and rigid metal conduit or EMT.

14. Cables shall be permanently identified at each end with an industry approved label.

15. All wall penetrations for telecommunications cabling must be firestopped, either sleeved with bushings at each end and plugged with removable/reusable firestopping material that has a minimum 2 hour rating, with EZ Path Fire-Rated Pathway, or in accordance with other architectural details, unless otherwise noted.

15.1. Cables must not be installed through unsleeved holes drilled through walls.

15.2. Comply with Division 07 requirements for Firestopping.

15.3. Comply with TIA 569 on Firestopping.

15.4. Comply with UL1479 or ASTM E814, and label with the UL1479 or ASTM E814 reference number.

16.1. The 2017 NEC, Article 770, Article 800, and Article 820 warns that paint, plaster, cleaners, abrasives, corrosive residues, or other contaminants may result in the alteration of communications cable properties, and therefore must under no circumstances be purposefully or inadvertently applied to communications cables.

16.2. If any such contaminants are applied to communications cables, then without exception either during construction or as a warranty repair, the affected cables must be removed and replaced immediately with new cables according the specifications of this document, and at no cost to the University.

17. For remodels and renovations in which jacks and/or station wire are to be removed or abandoned:

17.1. the jack/ports must be removed from the station end and the outlet covered with a blank plate,

17.2. the station wire/cabling must be removed in its entirety from the jack location to the telecommunications equipment room (IDF), and

17.3. the jack/port label(s) must be removed from the jackfield(s); if the associated jack/port is less than the current standard station wire Category rating, then the jack/port should also be removed from the jackfield.

27.04.60 TESTING and DOCUMENTATION

1. General

1.1. Acceptance testing shall be completed and documentation provided to the University as soon as possible in order to permit the installation of networking equipment necessary to bring the building online for security and equipment monitoring systems.

2. Testing

2.1. Acceptance testing by the University shall not occur until all work in the telecommunication closet area is completed, including but not limited to mounting and installation of fiber OSP and riser cables, backboards, terminating boxes and cabinets, and grounding blocks, and termination of fiber riser cables, copper backbone cables, station wires, or any other work necessary for the completion of the installation.

2.2. The University shall have the right to schedule acceptance testing at its convenience.

2.3. A University representative, at the option of the University, shall be present during testing.

2.4. Such acceptance testing shall in no way reduce the Contractors' obligations regarding restoration, cleanup, or warranty.

2.5. The telecommunications contractor/subcontractor shall perform tests necessary prior to acceptance testing to ensure that the installed cables will pass acceptance testing performed in conjunction with University representatives.

2.5.1. Acceptance testing includes verifying that each cable and conductor is properly labeled and in agreement at each end, also known as continuity testing.

2.5.2. As such, the telecommunications contractor/subcontractor's personnel must perform their own testing; subcontracting testing to an outside entity is not permitted.

2.6. Contractor shall be responsible for performing, tracking, and recording the results of tests.

2.7. Contractor shall be responsible for providing equipment and materials necessary for as long a period of time as necessary to complete testing to the satisfaction of the University.

2.8. The University must agree to test record forms and methods prior to the commencement of acceptance testing.

3. Documentation

3.1. Provide record plant documentation, including jack type (Information outlet), jack location, circuit length, fiber riser cable lengths, and copper backbone cable lengths and any other information deemed to be useful.

3.1.1. Additionally, provide a list of all existing jacks removed during project demolition phase(s).

3.2. The documentation format(s) will be agreed upon between the campus telecommunication coordinator and the contractor.

3.2.1 Provide all documentation in University approved electronic format.

3.2.2. If it is agreed to use proprietary software to provide testing results, the contractor will be required to furnish licensed system software to run it unless the University already has a licensed version of the contractor's software.

27.04.70 RECORD DRAWINGS

1. Provide updated drawings of telecommunications systems in CAD format.

2. As a minimum, the data provided must include the following elements, where applicable:

2.1. Inside Plant

2.1.1. Cable routing.

2.1.2. Riser and OSP cable, pair (count), locations, and final cable lengths.

2.1.3. Supporting structures.

2.1.4. Terminal locations and IDs.

2.1.5. Telecommunications Room and terminal details.

2.1.6. Conduit and cable tray routing, elevations installed at and section lengths.

2.1.7. Pull box locations, elevations installed at and sizes.

2.1.8. Information Outlet locations, label ID's, types, and serving Telecommunications Room

2.1.9. For each change reflected on the Record Drawings, the Change Order Request number shall be shown.

2.2. Substantial Completion Requirement

2.2.1. One month before the contractual Substantial Completion date, Contractor shall provide updated floor plans showing all known Information Outlets in contractually affected areas to be working at time of Substantial Completion, with actual jack label IDs and port counts.

2.2.2. These floor plans are for use by University groups for coordinating FF&E, employee location assignments and telecommunications service orders, as well as testing documentation and verification.

2.3. Outside Plant (provide on an accurate and scaled site plan)

2.3.1. Location of underground routes, indicating type (conduit, direct buried, etc.) and quantities.

2.3.2. Location of manholes and handholes.

2.3.3. Deviations from minimum depth requirements.

2.3.4. XYZ coordinates from 'permanent' landmarks.

2.3.5. Footages of conduit between maintenance holes.

2.3.6. Crossings of other utilities uncovered, including type and size of utility.

2.3.7. Location of outdoor emergency phone with conduit routing

27.04.80 WARRANTY

1. The warranty on labor and material installed by the Contractor shall be in effect for Five (5) years from the date of acceptance of the work.

2. Contractor shall repair, adjust, and/or replace, whichever the University determines to be in Its best interests, any defective equipment, materials, or workmanship, as well as such parts of the work damaged or destroyed by such defect, during warranty period, at the Contractor's sole cost and expense.

3. In the event that any of the equipment specified, supplied, and/or installed as part of the work should fail to produce capacities or meet design specification as published or warranted by the manufacturer of the equipment involved or as specified in this document, the Contractor shall, in conjunction with the equipment manufacturer, remove and replace such equipment with equipment that will meet requirements without additional cost to the University.

4. In the event that the Contractor does not affect repair within seven (7) days from the date of notification of such defect, the University may secure repair services from other sources and charge the Contractor for such costs without voiding the warranty.

5. Guarantees of material, equipment, and workmanship running in favor of the Contractor shall be transferred and assigned to the University on completion of the work and acceptance of said work by the University.

27.05.00 COMMON WORK RESULTS

27.05.05 SELECTIVE DEMOLITION

Not Applicable

27.05.09 RELATED SECTIONS

Section 26 – Common Work Result for Electrical
Section 26 – Low-Voltage Electrical Power Conductors and Cables
Section 26 – Grounding and Bonding for Electrical Systems
Section 26 – Hangers and Supports for Electrical Systems
Section 26 – Raceway and Boxes for Electrical
Systems Section 26 – Cable Trays for Electrical
Systems

27.05.26 GROUNDING and BONDING

1. Products specified in this Section shall be manufactured by a company with a minimum of three years' documented experience specializing in manufacturing such products.

2. DEFINITIONS (additional—see also 27.03.00)

2.1. Bonding: The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed. All exposed metal parts of the telecommunications system which are not intended to carry current must be bonded to the CBN (Ground Electrode System).

2.2. Common Bonding Network (CBN) (Ground Electrode System): Per ANSI T1.333-2001, a CBN is the principal means for effecting bonding and grounding inside a telecommunication building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network (BN) in a building. These components include structural steel or reinforcing rods, plumbing, alternating current (ac) power conduit, ac equipment grounding conductors (ACEGs), cable racks, and bonding conductors. The CBN always has a mesh topology and is connected to the grounding electrode system.

2.3. EMI (Electromagnetic Interference) - The interference in signal transmission or reception resulting from the radiation of electrical or magnetic fields.

2.4. Exothermic Weld: A method of permanently bonding two metals together by a controlled heat reaction resulting in a molecular bond.

2.5. Ground: A conducting connection, whether intentional or incidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

2.6. Grounding Electrode Conductor: The conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuit at the service equipment, or at the source of a separately derived system.

2.7. Mesh Bonding Network (Mesh-BN)(Ground Electrode System): A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding

grid, which is connected to multiple points on the common bonding network.

2.8. Primary Protector: A surge protective device placed on telecommunications entrance conductors in accordance with ANSI/NFPA 70 and ANSI/ATIS 0600318. and listed under ANSI/UL 497.

2.9. Telecommunications Main Grounding Busbar (TMGB): A busbar placed in a convenient and accessible location within the Building Telecommunication Main Equipment Room (IDF-1) which is in compliance with J-STD-607, and serves as a common point of connection for telecommunications system and equipment bonding to ground, as well as the common point of connection between other major building grounds and the Mesh Bonding Network (Ground Electrode System).

2.9.1. shall be pre-drilled copper or electro-tin plated busbar with holes to accommodate lug mounting holes, listed by a nationally recognized testing laboratory (NRTL).

2.9.2. shall be 0.25" thick x 4" wide with length sized for current applications and future growth.

2.9.3. shall be located to minimize ground wire lengths.

2.9.3.1. The TMGB mounting location shall be coordinated with University Information Technology Services representative and University electrical engineer.

2.9.4. shall be mounted at 18 inches above the floor in a location out of the way of other equipment.

2.9.5. shall be mounted to maintain a two (2) inch minimum clearance from the wall, using stand-off

insulators that comply with UL 891 for use in switchboards, 600V, made of Lexan or PVC impulse tested at 5000V.

2.9.6. shall be installed with clearances as required by applicable codes.

2.9.7. shall be mounted as close as practical to an electrical power panel if located in the same room, but no closer than 36" to a power panel or active electronics.

2.9.8. Unplated busbars shall be cleaned and have antioxidant applied before attaching grounding conductors.

2.9.9. shall have connections made with exothermic welding or two-hole compression lugs with a two-crimp minimum.

2.9.10. shall be bonded the building ground system ground or building structural steel with a copper ground wire of not smaller gauge than that used for the Telecommunications Bonding Backbone (TBB).

2.9.11. shall be bonded to the Alternating Current Electrical Ground (ACEG) with a copper ground wire of not smaller gauge than that used for the Telecommunications Bonding Backbone (TBB).

2.9.12. shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.

2.9.13. All ungrounded telecommunications racks and metallic raceways in the same room as the TMGB shall be bonded to the TMGB (see TEBC).

2.9.14. Telecommunications equipment racks shall have a grounding busbar connected to the TMGB.

2.9.15. Other connections to the TMGB include:

2.9.15.1. Primary protector

2.9.15.2. Outside plant cables

2.9.15.3. Backbone cables which contain a shield or metallic member

2.9.15.4. All metallic pathways for the telecommunications cabling located within the same room or space as the TMGB.

2.9.15.5. Cable tray

2.9.15.6. Ladder rack

2.9.15.7. Telecommunications equipment

2.9.15.8. TBB

2.9.15.9. TEBC

2.9.15.10. Primary protector grounding conductor, maintaining a minimum of 1 foot separation between this insulated conductor and any dc power cables, switchboard cable, or high frequency cables, even when placed in rigid metal conduit or EMT.

2.10. Telecommunications Grounding Busbar (TGB): A busbar placed in a convenient and accessible location within a Floor Telecommunication Equipment Room (IDF-2) that is in compliance with J-STD-607, and serves as a common point of connection for telecommunications system and equipment bonding to ground.

2.10.1. shall be pre-drilled copper or electro-tin plated busbar with holes to accommodate lug mounting holes, listed by a nationally recognized testing laboratory (NRTL).

2.10.2. shall be 0.25" thick x 2" wide with length sized for current applications and future growth.

2.10.3. shall be located to minimize ground wire lengths.

2.10.3.1. The TGB mounting location shall be coordinated with University Information Technology Services representative and University electrical engineer.

2.10.4. mount at 18 inches above the floor in a location out of the way of other equipment.

2.10.5. shall be mounted to maintain a two (2) inch minimum clearance from the wall, using stand-off insulators that comply with UL 891 for use in switchboards, 600V, made of Lexan or PVC impulse tested at 5000V.

2.10.6. shall be installed with clearances as required by applicable codes.

2.10.7. shall be mounted as close as practical to an electrical power panel if located in the same room, but no closer than 36" to a power panel or active electronics.

2.10.8. Unplated busbars shall be cleaned and have antioxidant applied before attaching grounding conductors.

2.10.9. shall have connections made with exothermic welding or two-hole compression lugs with a two-crimp minimum.

2.10.10. shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.

2.10.11. All ungrounded telecommunications racks and metallic raceways in the same room as the TGB shall be bonded to the TGB (see TEBC).

2.10.12. Telecommunications equipment racks shall have a grounding busbar connected to the TGB.

2.11. Telecommunications Equipment Bonding Conductor (TEBC): A conductor or conductors that connect the telecommunications main grounding busbar (TMGB) or telecommunications grounding busbar (TGB) to equipment racks and cabinets.

2.11.1. shall be a continuous copper conductor sized according to the conductor table under TBB.

2.11.2. shall be separated from ferrous materials by 2 inches, or be bonded to the ferrous material.

2.11.2.1. may be routed within cable trays, or suspended 2 inches under or off the side of a cable tray or ladder rack.

2.11.3. shall be supported every 3 feet.

2.11.4. shall be installed with a minimum of 8-inch bend radii of no more than a 90 degree bend.

2.11.5. may contact other cable groups at a 90 degree angle only.

2.11.6. Metallic cable shields may not be used as a TEBC.

2.11.7. Includes RBCs and UBCs.

2.12. Telecommunications Bonding Backbone (TBB): A conductor that interconnects the Telecommunications Main Grounding Busbar (TMGB) in the MDF/IDF-1 to Telecommunications Grounding Busbars (TGBs) in the IDF-2(s).

2.12.1. The intended function of a TBB is to reduce or equalize potential differences between telecommunications systems; while the TBB will carry some current under ac power ground fault conditions, it is not intended to provide the only ground fault return path.

2.12.2. The TBB shall be constructed with copper ground wire solid or stranded, insulated or uninsulated as approved the University, and sized according to length, as detailed in J-STD-607, shown below:

WIRE LENGTH WIRE SIZE (AWG)

<4 m / < 13 ft	6
4-6 m / 14-20 ft	4
6-8 m / 21-26 ft	3
8-10 m / 27-33 ft	2
10-13 m / 34-41 ft	1
13-16 m / 42-52 ft	1/0
16-20 m / 53-66 ft	2/0
> 20 m / > 66 ft	3/0

2.12.3. As sized above, a continuous ground wire shall be run from the TMGB in the outside plant cable entrance telecommunications room (MDF/IDF-1/BDF) to the TGB in the highest/last IDF in each of any stacks of IDFs; the TGB in each intermediate IDF in a given stack shall be H-tapped to the continuous grounding riser/TBB.

2.12.3.1. Connections to the Conductor shall be made with irreversible compression connectors.

2.12.3.2. Taps shall be UL & CSA listed.

2.12.3.3. Taps shall be able to accept 6 AWG to 3/0 AWG.

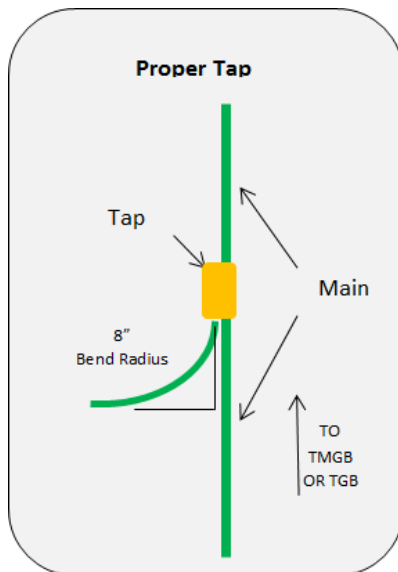
2.12.3.4. Taps shall have a traceable feature to ensure proper die size was used to make the crimp.

2.12.3.5. Taps require a minimum of (2) crimps for C Tap and H Tap, 1 crimp for I-Beam and busbar Tap.

2.12.3.5.1. Crimp according to manufacturer's recommendation.

2.12.3.6. Minimize the amount of insulation removed for installing the compression connector.

2.12.3.7. Taps shall be installed as shown in the following diagram:



2.12.4. TBB conductors should be installed in metal conduit for protection and ease of replacement everywhere inside the building, except as follows:

2.12.4.1. inside MDF/IDF rooms.

2.12.4.2. between stacked MDF/IDF rooms where the sleeve through the floor is less than three (3) feet.

2.12.5. TBB conductors in metal conduit must utilize grounding bushings at both conduit ends.

2.12.6. Multiple TBB runs may be required as dictated by building size and layout.

2.12.7. Metallic cable shields may not be used as a TBB.

2.13. Grounding Equalizer (GE): A bonding conductor that interconnects TGBs on the same floor, top floor, and every third floor of a multistory building (formerly TBBIBC).

2.13.1. The GE shall be sized according to the conductor table under TBB.

2.13.2. Metallic cable shields may not be used as a GE.

2.14. Rack Bonding Conductor (RBC): A bonding conductor used to connect the rack/cabinet directly to the TMGB/TGB/Mesh.

2.14.1. Metallic enclosures, including telecommunications cabinets and racks, shall be bonded to the mesh- BN, TGB, or TMGB using a minimum sized conductor of No. 6 AWG.

2.14.2. Cabinets, racks, and other enclosures in computer rooms must not be bonded serially; each shall have their own dedicated bonding conductor to the mesh-BN, TGB, or TMGB

2.15. Unit Bonding Conductor (UBC): A bonding conductor used to connect a rack/cabinet mounted equipment unit to the grounding structure (i.e. conductor, busbar) utilized in that rack/cabinet.

2.16. Electrical Distribution Panel (EDP): In existing room installations only; new construction must not have EDPs located in the same room as telecommunications equipment.

2.16.1. When located in the same room as the TMGB/TGB the EDP's equipment grounding bus or the panel board enclosure shall be bonded to the TMGB/TGB.

2.16.2. Using a bonding conductor for telecommunications (BCT) minimum 6 AWG to a maximum of 3/0 AWG depending on the length of cable required.

2.16.2.1. BCT should be installed in metal conduit for protection and ease of replacement everywhere inside the building, except as follows:

2.16.2.1.1. inside MDF/IDF rooms.

2.16.2.1.2. between stacked MDF/IDF rooms where the sleeve through the floor is less than three (3) feet.

2.16.2.2. BCT in metal conduit must utilize grounding bushings at both conduit ends.

2.16.3. Use same AWG as TBB.

2.16.4. A qualified electrician shall make all connections within an ac electrical panel.

2.16.5. Outside of the scope of ANSI/TIA-607B.

2.17. Conductive Cables contain metallic components that are capable of transmitting current.

2.17.1. Conductive cables should be bonded and grounded as specified in NEC Article 770.100.

2.17.2. Fiber optic cables may be conductive or non-conductive.

2.17.3. Telecommunications cables with metallic sheath members shall be bonded together at splices with a #6 solid or stranded copper ground wire and bonded to the TMGB or TGB.

2.17.4. Cable shields (of cables not installed in ferrous metal conduit elsewhere grounded) shall be grounded to a tested and proven earth ground within 50 feet of entering any building with an independent #6 solid or stranded copper ground wire or other electrically equivalent method as approved by the University.

2.18. Ladder Rack and/or Cable Tray Potential Equalization is achieved when all cable runway sections are bonded together and bonded back to the TMGB or TGB in a Telecommunications Room.

2.18. Maintain an 8" Bend Radius on the TEBC

2.18. Keep a 2" separation from other cables, power and telecommunications

2.18. Remove any paint, oxidation, etc. from the runway surfaces that are being bonded

2.18. Drill two holes as required to accommodate the 2-hole compression lug

2.18. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.

2.18. Attach straps to the runway using stainless steel hardware sized for the lug holes.

2.18. Tighten the hardware

2.18. Wipe off any excess antioxidant after installation of the lug.

3. Labeling of Telecommunication Grounding System

3.1. The format for the telecommunications main grounding busbar shall be FS-TMGB, while the format for the TGBs shall be FS-TGB.

3.1.1. FS is the TS identifier for the space containing the busbar; Floor & space

3.1.2. TMGB is the portion of an identifier designating a telecommunications main grounding busbar;

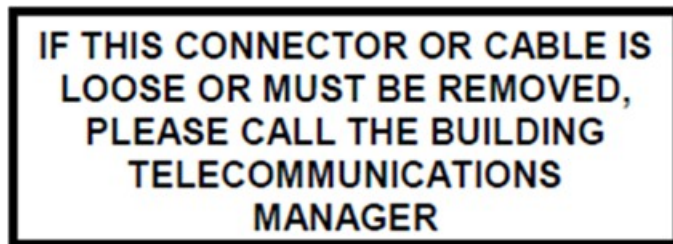
3.1.3. TGB is the portion of the identifier designating a telecommunications grounding busbar.

3.2. Each telecommunications space or room shall be assigned an identifier unique within the building.

3.2.1. The TS shall be labeled with the TS identifier inside the room so as to be visible to someone working in that room.

3.2.2. The TS identifier shall have a format of FS.

3.3. All busbars and cables will have the following label attached in a visible location and in a readable format:



4. Testing of Telecommunication Grounding System

4.1. Testing shall be performed with an earth ground resistance tester, and not a standard Volt-Ohm- multimeter.

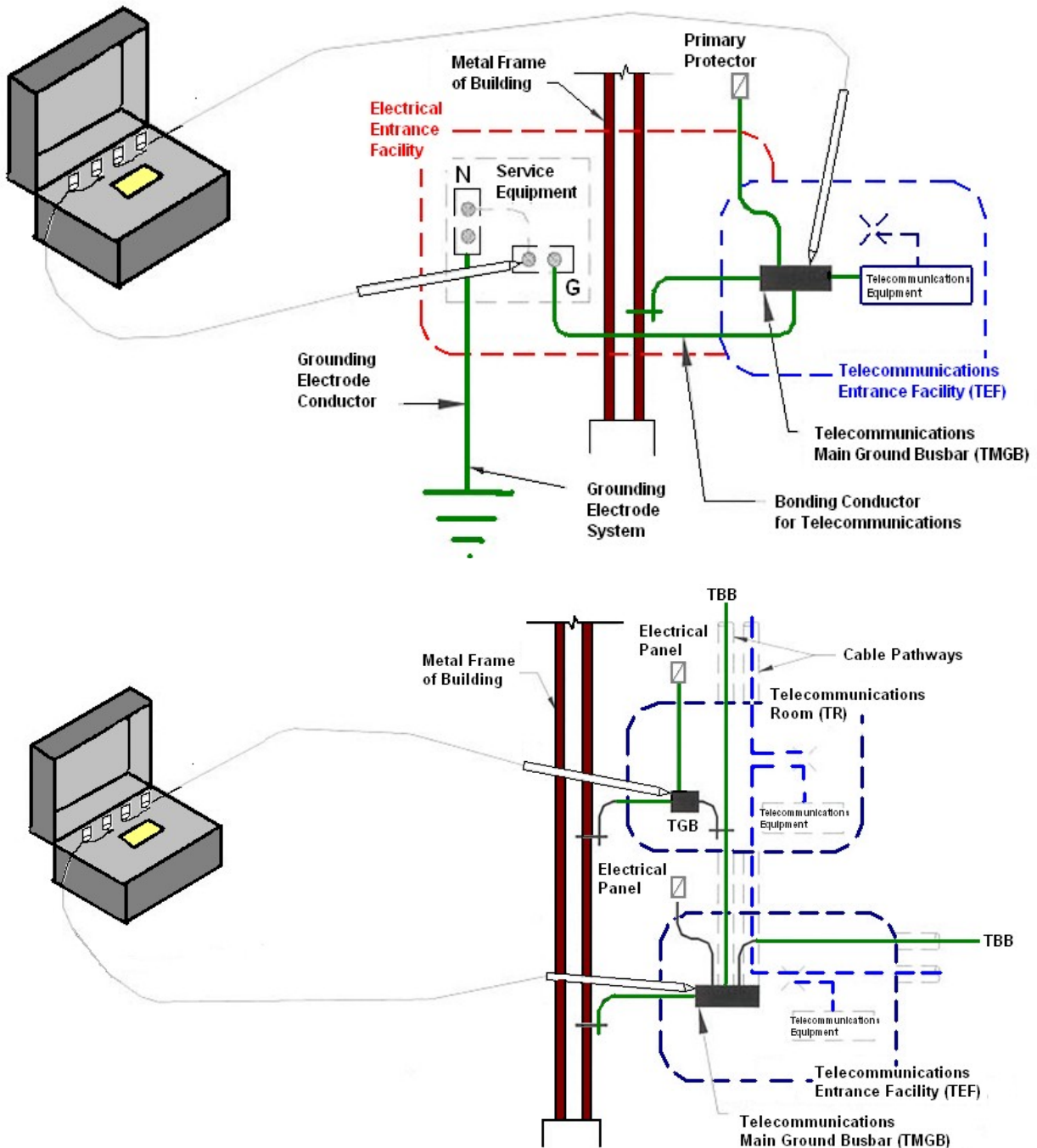
4.1.1. Perform two-point ground continuity testing.

4.1.2. Maximum value 100 milliohms.

4.1.3. Follow manufacture instructions on setup and how to perform the test.

4.1.4. Care should be taken and safety precautions in place.

4.1.5. Record and submit ground test results.



27.05.28 PATHWAYS

1. Cable paths must be designed and installed in a manner which allows reasonable access to add or remove cables for future demand and maintenance purposes, including capacity for future growth.
 - 1.1. It is the financial responsibility of the contractor to install sufficient pathway capacities to meet the

requirements stated in the following sections 27.05.33, 27.05.36, 27.05.39 and 27.05.43.

1.2. It is the responsibility of the contractor to install pathways which upon project completion will remain readily accessible by telecommunication cable installers.

2. Separation from EMI sources:

2.1. Open cables and cables in nonmetallic raceways and unshielded power:

- 2.1.1. Electrical less than 2 kVa 5 inch minimum
- 2.1.2. Electrical 2 to 5 kVa 12 inch minimum
- 2.1.3. Electrical greater than 5 kVa 24 inch minimum

2.2. Cables in grounded metallic raceways and unshielded power:

- 2.2.1. Electrical less than 2 kVa 2-1/2 inch minimum
- 2.2.2. Electrical 2 to 5 kVa 6 inch minimum
- 2.2.3. Electrical greater than 5 kVa 12 inch minimum

2.3. Cables in grounded metallic raceways and shielded power:

- 2.3.1. Electrical less than 2 kVa 1 inch minimum
- 2.3.2. Electrical 2 to 5 kVa 3 inch minimum
- 2.3.3. Electrical greater than 5 kVa 6 inch minimum

2.4. Cables and electrical motors and transformers 5 kVa or larger 48 inches

2.5. Cables and fluorescent fixtures 5 inches

27.05.29 HANGERS and SUPPORTS

1. Hanger and supports must be NRTL (Nationally Recognized Testing Laboratories) labeled for support of Category 6A cabling.

2. J-hooks shall be installed where no provisions for cabling runways.

3. J-hooks shall be installed per ANSI/TIA 569 Commercial Building Standards for Telecommunications Pathways and Spaces, including a maximum distance between j-hooks of five (5) feet, but with varied spacing to avoid the production of electrical harmonics in the high-speed data cabling.

27.05.33 CONDUITS and BACKBOXES

1. Horizontal distribution conduit shall be installed from junction box joining each station conduit box to the floor telecommunications equipment room, assuming worst allowable case of 180° of conduit bend from pull point to pull point, to be sized per the following table:

EMT Conduit Trade Size	Category 6A Station Cables
1"	2
1-1/4 "	4
1-1/2 "	6
2"	12
2-1/2 "	18
3"	26
3-1/2 "	38
4"	48

The conduit fill table is based on BICSI's recommended 40% derated fill recommendation as calculated in the following table for horizontal station cables.

NEW CONSTRUCTION													
----- (inches) -----					NEW CONSTRUCTION			90 Degrees of Bend			180 Degrees of Bend		
EMT Conduit Trade Size	Cat 6A Cable Diameter	Conduit Area	Cable Area	100% Fill	Bends (NONE)	40% Fill	Cables	Bends	40% Fill Derated	Cables	Bends	40% Fill Derated	Cables
1.00	0.275	0.7850	0.0594	13.223	0	5.289	4	1	4.496	4	2	3.702	2
1.25	0.275	1.2266	0.0594	20.661	0	8.265	8	1	7.025	6	2	5.785	4
1.50	0.275	1.7663	0.0594	29.752	0	11.901	10	1	10.116	10	2	8.331	8
2.00	0.275	3.1400	0.0594	52.893	0	21.157	20	1	17.983	16	2	14.810	14
2.50	0.275	4.9063	0.0594	82.645	0	33.058	32	1	28.099	28	2	23.140	22
3.00	0.275	7.0650	0.0594	119.008	0	47.603	46	1	40.463	40	2	33.322	32
3.50	0.275	9.6163	0.0594	161.983	0	64.793	64	1	55.074	54	2	45.355	44
4.00	0.275	12.5600	0.0594	211.570	0	84.628	84	1	71.934	70	2	59.240	58

NEW CONSTRUCTION													
----- (inches) -----					NEW CONSTRUCTION			90 Degrees of Bend			180 Degrees of Bend		
EMT Conduit Trade Size	Cat 6A Cable Diameter	Conduit Area	Cable Area	100% Fill	Bends (NONE)	40% Fill	Cables	Bends	40% Fill Derated	Cables	Bends	40% Fill Derated	Cables
1.00	0.300	0.7850	0.0707	11.111	0	4.445	4	1	3.778	2	2	3.111	2
1.25	0.300	1.2266	0.0707	17.361	0	6.945	6	1	5.903	4	2	4.861	4
1.50	0.300	1.7663	0.0707	25.000	0	10.000	10	1	8.500	8	2	7.000	6
2.00	0.300	3.1400	0.0707	44.444	0	17.778	16	1	15.111	14	2	12.444	12
2.50	0.300	4.9063	0.0707	69.444	0	27.778	26	1	23.611	22	2	19.444	18
3.00	0.300	7.0650	0.0707	100.000	0	40.000	40	1	34.000	32	2	28.000	26
3.50	0.300	9.6163	0.0707	136.111	0	54.445	54	1	46.278	46	2	38.111	38
4.00	0.300	12.5600	0.0707	177.778	0	71.111	70	1	60.444	60	2	49.778	48

2. Junction boxes shall be sized according to NEC 314.28, NEC 314.54, Article 770, and to accommodate bending radiuses as discussed in NEC 300.34 and related TIA documents.

2.1. In any case, all methods employed for the installation of interior communication cables should not subject the cables to a bend radius less than the following minimums:

2.1.1. Copper riser communication cables, bending radius not smaller than 8 times the cable diameter.

2.1.2. Copper station communication cables:

2.1.2.1. In conduit, bending radius not smaller than three (3) inches, or 8 times the cable diameter, whichever is greater.

2.1.2.2. In furniture, where the cable is not subject to high pulling tensions, bending radius not smaller than 4 times the cable diameter.

2.1.3. Fiber optic cables, during pulling operations, should not exceed a bending radius smaller than 20 times the cable diameter, or as recommended by the cable manufacturer; after pull is complete, the final cable bend radius should not exceed 10 times the cable diameter.

3. Conduits for copper and fiber riser cables shall be sized to no greater than 40% derated fill.

4. Conduits for interior grade telecommunication cables, such as riser rated and horizontal station cables, may be placed in a slab-on-grade or in a slab above crawl space, but must never be placed below the slab for any reason. Likewise, horizontal station cables must not be placed in conduit which is exposed to outside weather conditions. Inside building rated cables are not designed to withstand the moisture and condensation which can occur in underground and exterior conduits, which will render the cable(s) unusable in a short period of time. Although such conduits may be placed in the slab as a last result, whenever possible conduits should be placed above slab, but never below.

27.05.36 CABLE TRAYS

1. Horizontal distribution: Cable trays are to be installed as low as possible above the finished ceiling.

1.1. A clearance of 12" shall be maintained above the trays.

1.2. 90° turns shall be made by two (2) 45° turns.

1.3. Cable trays shall not be installed using center point mounts.

1.4. Cable tray outside the IDFs shall be large enough that all of the telecommunication cabling installed as part of a project will not produce a fill ratio greater than 70% of the manufacturer's stated capacity.

2. Telecommunication Rooms (IDFs): In IDFs, ladder type cable tray shall be sized as indicated in the following table, based on the Chatsworth Cable Fill Capacities chart for their 10250-Xnn products:

CABLE TRAY CAPACITIES & ROOM SIZES			
Racks	Category 6A Tray Minimum		
	Cables	Width	Room Size
One	1-250	12-inch	10'x11'
Two	251-382	18-inch	10'x11'
Two	383-500	24-inch	10'x11'
Three	501-637	30-inch	14'x14'
Three	638-792	36-inch	14'x14'

2.1. Install ladder tray one size larger above the equipment rack(s), secured and braced as necessary to stabilize the end of the rack(s). (See diagrams)

2.1. Mount ladder tray at a minimum 7' height.

2.2. Install cable tray systems such that cables will transition to the ladder rack runway without damage to or strain on the cables.

2.4. Use additional ladder rack where necessary to stabilize equipment racks in the room or as needed to provide reasonable and shortest distance routing of cables.

3. Refer to Division 26.

27.05.39 SURFACE RACEWAYS

1. Cables must not be subjected to sharp or binding edges.
2. Surface raceways must be large enough to accommodate all intended telecommunications cables as well as allow for 30% growth.
3. Such raceways and pathways shall installed to support horizontal cabling in accordance with the requirements of ANSI/TIA-569-C.
4. Refer to Division 26.

27.05.43 UNDERGROUND DUCT SYSTEMS and RACEWAYS

1. Maintenance holes

1.1. Manholes

- 1.1.1. Manholes shall be precast concrete 12x6x7 A-hole or J-hole type with sump hole.
- 1.1.2. Manholes shall have 32" diameter heavy-duty cast iron lids with penta-head bolts.
- 1.1.3. Lids shall be labeled "Communications".
- 1.1.4. Manholes shall have manufacturer's pulling irons installed.
- 1.1.5. Beginning from center of the side walls, manufacturer's manhole racking shall be installed 24" OC.
- 1.1.6. Manholes shall be fitted with a manufacturer's recommended iron ladder.

1.2. Handholes

- 1.2.1. Where not otherwise specified, handholes shall be 4x4x4 precast concrete with sumphole.
- 1.2.2. Precast handholes shall have 32" diameter heavy-duty cast iron lids with penta-head bolts.
- 1.1.3. Lids on all types of handholes shall be labeled "Communications".

2. Duct type

- 2.1. Trenched ducts shall be Schedule 40 PVC.
- 2.2. Directionally bored ducts shall be HDPE SDR 11, orange in color.
- 2.3. Both shall be 4" ID nominal trade size, unless specified otherwise.
- 2.4. NOTE: Innerduct is no longer used in outside plant communications ducts on Indiana University campuses.

3. Duct Installation

3.1. Trenched Ducts

- 3.1.1. Trenched ducts shall be installed with a minimum of 36" of cover (see following illustration), and according to manufacturer's instructions.
- 3.1.2. Ducts shall be separated and held in place with duct spacers at intervals of no more than 8 feet.
- 3.1.3. Corners and bends of duct runs shall be installed with minimum 48-inch radius sweeps, encased in concrete.
 - 3.1.3.1. Ducts must NOT be bent by heating with an open flame. Use factory sweeps, or bend conduit using devices such as Bendit which are designed to allow bending of PVC conduit without compromising the diameter and conduit material. Use bending devices in accordance with manufacturer's instructions.
- 3.1.4. Ducts shall be installed with a minimum of 4" of fall per 100' toward maintenance holes and away from buildings.
- 3.1.5. Ducts shall be surrounded by a minimum of 3" on all sides with flowable backfill

3.1.6. Ducts shall then be capped with a minimum 3" (4" preferred) concrete no less than the width of the backfilled trench.

3.1.7. Color top of concrete cap by using Orange chalk dust while still wet.

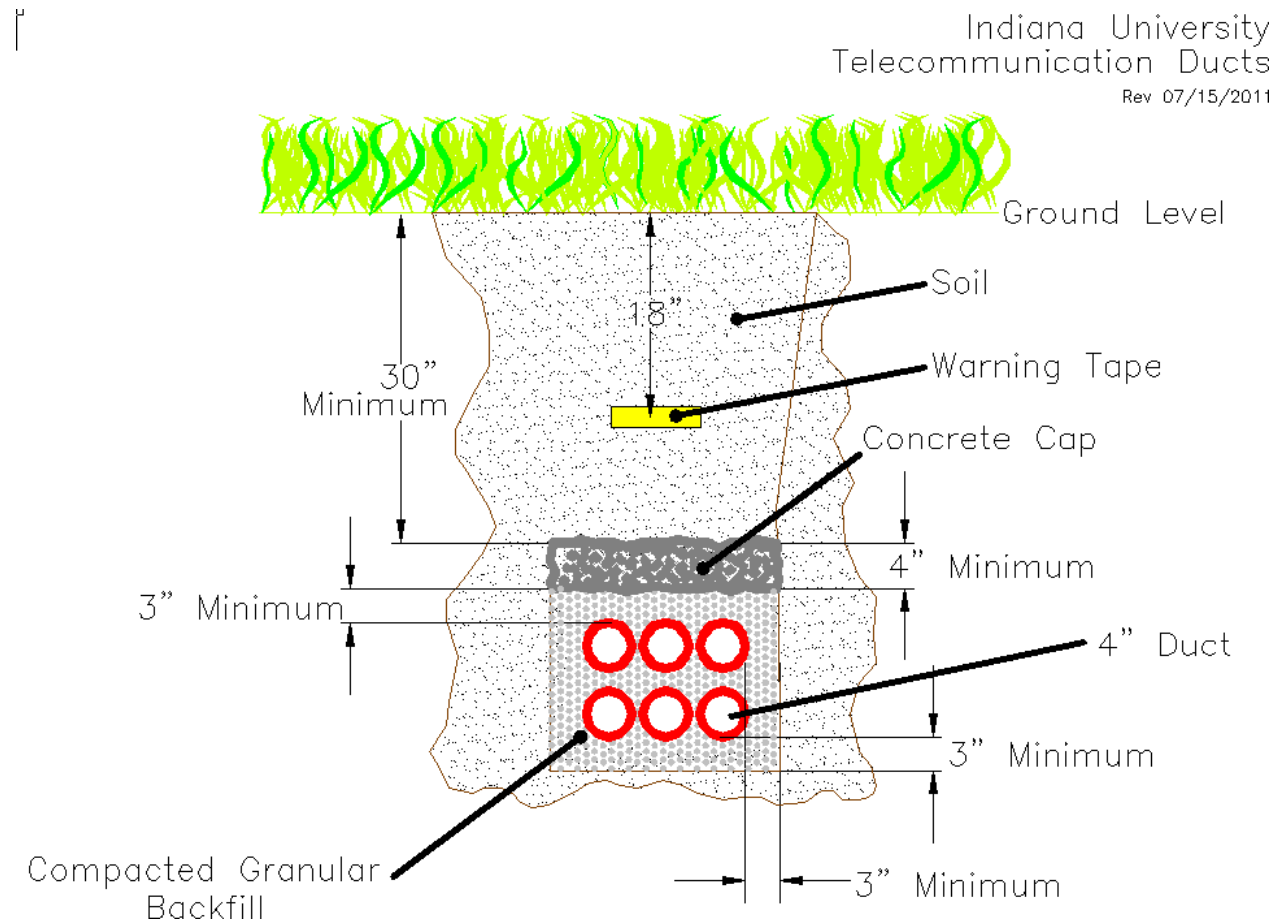
3.1.8. An orange magnetically detectable warning tape shall be installed above the top of the ductbank, 18" below ground level (see following illustration).

3.1.9. Ducts shall be sealed around their outer edges with hydraulic cement to prevent leakage into manholes.

3.1.10. Unused ducts shall be plugged at both ends using compression type fittings.

3.1.11. Seal maintenance hole penetrations using hydraulic cement.

3.1.12. See also 3.3.



3.2. Directionally bored ducts

3.2.1. Directionally bored ducts shall be installed with a minimum of 30" of cover, and according to manufacturer's instructions.

3.2.2. Corners and bends of duct runs shall be installed with minimum 48-inch radius sweeps.

3.2.3. Ducts shall be installed with a minimum of 4" of fall per 100' away from buildings.

3.2.4. HDPE ducts shall be installed in continuous runs from maintenance hole to maintenance hole, unless otherwise specified and approved by the appropriate UITs representative.

3.2.4.1. If couplings are approved, couplings shall be of a type which provides air and water-tight integrity for internal pressures over 200 psi.

3.2.5. See also 3.3.

3.3. Both

3.3.1. Ducts shall be installed a minimum of 12" from electrical conduits for circuits of 5 kVa or less, a minimum of 24" for circuits greater than 5 kVa, and a minimum of 48" from transformers.

3.3.2. Duct shall be installed with as much separation from steam lines as is practical.

3.3.3. Where possible, ducts shall be terminated into precast cutout locations.

3.3.4. Duct shall NOT penetrate manholes in the collars, in the middle of side walls, at locations blocked by existing cables in the case of existing manholes, or in a location which blocks unused ducts.

3.3.5. Terminated duct penetrations into manholes, precast handholes, and building entrance wall penetrations which do not land in a pull box must be terminated flush to the wall(s) using the type of bell end illustrated below.



3.3.6. Duct penetration locations should allow for easy racking of cables around manhole walls.

4. Building penetrations

4.1. Building entrance ducts which penetrate the floor must extend high enough up for installation of a bushing to protect the cable sheath from the edges of the conduits

4.1.1. Bushing finished top shall be no higher than 8 inches from the floor.

5. Installed Duct Preparation

5.1. Pull round wood or steel test mandrel of recommended size through each duct from both directions to remove obstructions and prove the duct is usable.

5.1.1. Sections of duct which are proven unusable must be replaced and new duct tested again.

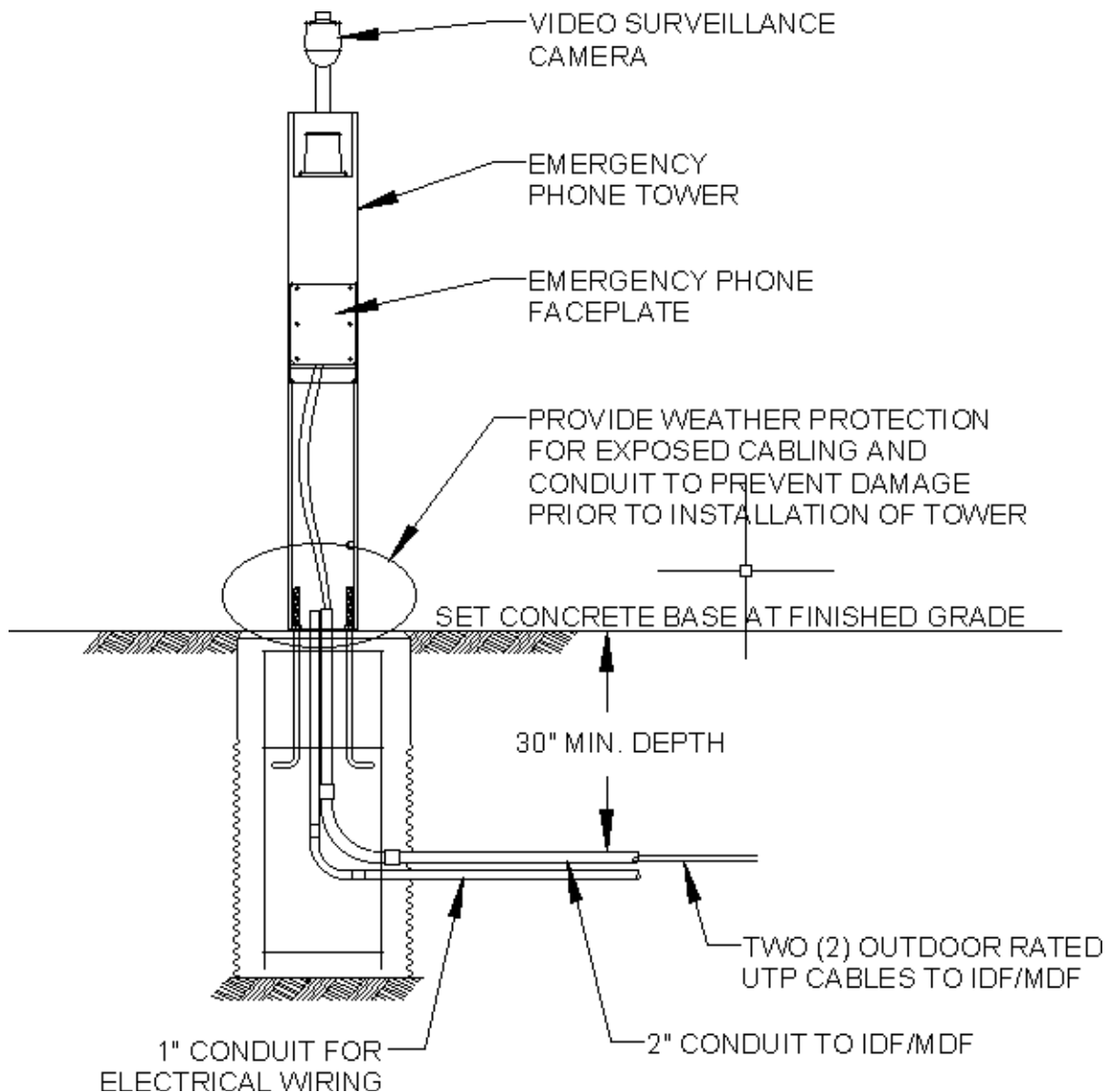
5.2. Pass a wire brush mandrel and/or a rubber duct swab of appropriate size through each duct until all foreign materials and water are removed.

5.3. Ducts shall be provided with Greenlee, Muletape, or equal continuous measuring tape in each duct.

5.4. Install a locate wire in one duct of each conduit run and terminate on collar of manholes for easy access.

5.5. Unused ducts shall be plugged using compression type fittings

6. Outdoor Emergency Phone Detail



NOTE: Current as of 10/2/2018. Log in to <https://app.e-builder.net> to retrieve latest version, under "zIUResources – BL", "Standard Front End Docs", "IU Standards", "Electrical Standards", "20XX – IU Electrical Design Standards.pdf"

Additional cable and/or electronic treatments may be necessary, depending on cable distance (copper data cables not to exceed 295 feet) or other situational requirements.

27.05.53 IDENTIFICATION

1. Comply with Section 27.15.43
2. Otherwise, identify system components according to TIA 606-B.

27.06.00 SCHEDULES for COMMUNICATIONS

See 27.04.50 GENERAL INSTALLATION

Firestop (non-hardening compounds only)

FIRE-STOP 3M MP+1.4"x11"
FIRE-GRMT2PC Specified Technologies RFG2
FIRE-PILL941 Specified Technologies SSB14
FIRE-PILL942 Specified Technologies SSB24
FIRE-PILL962 Specified Technologies SSB26
FIRE-PILL963 Specified Technologies SSB36
Firestop, 36 ci tube Specified Technologies SSP100

See 27.05.26 GROUNDING

Grounding Busbars Comply with J-STD-607-B

TMGB

4" X 16" Copper Hubbell HBBB14416H or equivalent 4" X 16" Tin Plated Copper Hubbell HBBB14416HTP or equivalent 4" X 20" Copper Hubbell HBBB14420J or equivalent 4" X 20" Tin Plated Copper Hubbell HBBB14420JTP or equivalent

TGB

2" X 10" Copper Hubbell HBBB14210A or equivalent 2" X 10" Tin Plated Copper Hubbell HBBB14210ATP or equivalent 2" X 24" Copper Hubbell HBBB14224B or equivalent 2" X 24" Tin Plated Copper Hubbell HBBB14224BTP or equivalent

Horizontal Cabinet or Equipment Rack Busbar – 19"

Grounding busbar kit, 19" Panduit RGRB19_ (shown in drawings) 0.75"x19" x 0.25"
Copper Hubbell HBBBHR19KT or equivalent 0.75"x19" x 0.25" Tin Plated Copper Hubbell HBBBHR19KTTP or equivalent

Vertical Cabinet or Equipment Rack Busbar – 36" to 72"

0.75" x 36"x0.25" Copper Hubbell HBBBVR36KT or equivalent 0.75"x36"x0.25" Tin Plated Copper Hubbell HBBBVR36KTTP or equivalent

Compression Lugs

0.250" holes X 0.625" spacing
0 degrees Hubbell HGBLXXD or equivalent
45 degrees Hubbell HGBLXXD45 or equivalent
90 degrees Hubbell HGBLXXD90 or equivalent 0.250" holes x 0.750" spacing
0 degrees Hubbell HGBLXXDA or equivalent 0.375" holes x 1.000" spacing
0 degrees Hubbell HGBLXXDB or equivalent
90 degrees Hubbell HGBLXXDB90 or equivalent

C Tap

Main Run 6-4 AWG - Tap 6 AWG Hubbell HYC4C6 or equivalent Main Run 6-4 AWG – Tap 4 AWG Hubbell HYC4C4 or equivalent Main Run 2 AWG – Tap 8-4 AWG Hubbell HYC2C4 or equivalent Main Run 2 AWG – Tap 2 AWG Hubbell HYC2C2 or equivalent Main Run 1/0-2/0 AWG–Tap 8-2 AWG Hubbell HYC26C2 or equivalent Main Run 1/0-2/0 AWG–Tap 1/0-2/0 AWG Hubbell HYC26C26 or equivalent

H Tap

Main Run 4/0-2 AWG - Tap 2-8 AWG Hubbell HYH292C or equivalent Main Run 2-8 AWG
– Tap 2-8 AWG Hubbell HYH2C2C or equivalent Main Run 6-10 AWG – Tap 6 AWG
Hubbell HYH6C6C or equivalent

I-Beam Tap

I-Beam steel with a Standard Flange Hubbell HYGIBS##### or equivalent I-Beam steel with
a Wide Flange Hubbell HYGIBW##### or equivalent

Busbar Tap

Busbar thickness 0.25", Main Run 2 AWG - Tap 6 AWG
Hubbell HYG14B2TC2C6C or equivalent Busbar
thickness 0.25", Main Run 2 AWG – Tap 2 AWG
Hubbell HYG14B2TC2C2C or equivalent Busbar
thickness 0.25", Main Run 4/0 – 1/0 AWG
Hubbell HYGBTC28 or equivalent

Ladder Rack Bonding Conductors

Stranded THHN, green Hubbell HGRKTD12D or equivalent Stranded THHN, green Hubbell
HGRKTKA9KA5 or equivalent Stranded THHN, green Hubbell HGRKTKLU9KLU5 or
equivalent Braided Jumper Hubbell HGBBD12 or equivalent

Basket Tray Conductors Hubbell HGBKS17 or equivalent

Hubbell HGRKTWC45 or equivalent Hubbell
HGRKTWB5 or equivalent

Wrist Strap ESD Port Hubbell HGBESDKT10 or equivalent

Raised Floor Grounding Clamp

Grid or Parallel Hubbell HGBGXP1828RF or equivalent
Parallel Hubbell HGBGP1526G1 or equivalent
Parallel Hubbell HGBGRF4C3 or equivalent

Stringer 0.75"-1.5" Round or Square Hubbell HGBGXP1828RF or equivalent Stringer 1.0"-
1.25" Round Hubbell HGBGP1526G1 or equivalent Stringer 0.75"-1.0" Round or Square
Hubbell HGBGRF4C3 or equivalent

Wire Range 6 – 4/0 AWG Hubbell HGBGXP1828RF or equivalent Wire Range 4 – 2/0 AWG
Hubbell HGBGP1526G1 or equivalent Wire Range 8 – 2 AWG Hubbell HGBGRF4C3 or
equivalent

See 27.05.29 HANGERS

Horizontal Cable Hangers Panduit J-Pro Series (preferred)

Horizontal Cable Hangers Panduit J-Mod series

Horizontal Cable Hangers Erico Caddy CAT J-Hook: Cat32

Horizontal Cable Hangers Erico Caddy CableCat Wide Base Cable Support Clips

See 27.05.33 CONDUITS and BACKBOXES

Refer to following section on Information Outlets, referencing "See 27.15.43"

See 27.05.36 CABLE TRAY

Cable Tray through building Comply with NEMA VE 2 and TIA-569 cable tray
(Not in IDF) or cable basket 12" or larger as required by manufacturer's specifications

See 27.05.43 UNDERGROUND DUCTS and RACEWAYS

Manholes 12x6x7 A-hole or J-hole type with sump hole
with manufacturer's racking hardware, pulling irons,
and manufacturer's iron ladder

Manhole Ducts 4" nominal trade size Schedule 40 PVC.

Handholes 4x4x4 precast concrete with sump hole
Handhole ducts Schedule 40 PVC, or ducts suitable for directional boring

Duct fittings (either) Bell type fittings
Duct plugs (either) Compression type fittings

See 27.11.13 ENTRANCE PROTECTION

Solid-state 4-pair protector unit for Outdoor Devices:
For POE circuits (power over Ethernet) minimum 48V (*cameras, WAPs, for instance*) For
Analog circuits minimum 96V (*dial tone circuits*)

For both OSP Entrance Cables and Outdoor Devices:
Circa Building Entrance Terminal 110 Connector Series, by pair count Circa Gas
Tube Module Circa 3B1E

See 27.11.16 EQUIPMENT RACKS

7'x19" Equipment Rack Panduit CMR19x84 Wire Management
Horizontal Panduit WMPH2E
Wire Management Intermediate 12" Panduit Patchrunner PR2VD12 Wire
Management End Panel Panduit PREPB1
Tie bracket

Equipment Cabinet (for small buildings) Cooper B-Line VLWM2425PB (use must
be pre-approved) Plexiglas door, Black

See 27.11.19 TERMINATIONS

Copper backbone Termination Block Panduit Pan-Punch 110 Category 5e system Horizontal
Copper Cabling Patch Panel

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072
Chemistry Addition - Research Labs Renovation
Bloomington, Indiana
IU Project No. 20240397 / BSA Project No. 00360477

MDF/IDF Panduit CPPLA24WBL Y
Equipment Cabinet (small bldgs.) Panduit CPPL24M6BL Y
Voice Patch Panel Panduit VP24382TV25Y with RJ21 connector

Patch Panel Jack Modules:

For 6A station wire Panduit CJ6X88TGV L TX6 PLUS, Violet, Cat 6A

Corning Fiber Terminations for Outside Plant Terminations Only

Corning Connector Housing: 2 Rack Unit Housing - CCH-02U
4 Rack Unit Housing - CCH-04U

Corning Coupler Panels: 12 port LC APC Panel - CCH-CP12-B3 24 port LC APC Panel -
CCH-CP24-B3

Corning CCH Splice Cassettes: 12 strand LC APC Cassette – CCH-CS12-B3-P00RE
24 strand LC APC Cassette – CCH-CS24-B3-P00RE

Sumitomo Fiber Terminations (for Sumitomo cables only):

1U Termination Unit Sumitomo FT01RU3P Rack Mount Panel (requires prior UITS
approval)

2U Termination Unit Sumitomo FT02RU4P Rack Mount Panel (requires prior UITS
approval)

4U Termination Unit Sumitomo FT04RU12P Rack Mount Panel (standard / preferred)

PrecisionFlex OM4 LC 12F FTLC-MP12COM4-L-U
cassette universal

PrecisionFlex SM LC/APC 12F LGX FTLC-MP12COS2-LA-U
cassette universal

Splice Tray, 12 Mass/24 Single ST-01

See 27.11.23 CABLE MANAGEMENT and LADDER RACK

Ladder Rack (in IDF) Chatsworth 10250-712* (12" or wider, as required) for up to 180 Cat 6A
cables**

Chatsworth 10250-718* (18" or wider, as required) for
up to 270 Cat 6A cables**

* associated parts, as required

** based on the Chatsworth "Estimated Cable Fill Capacities"
chart, under "Recommended Fill" for Cat 6A wiring since IU
does not use the "cable retaining posts" on new installs.
Refer to chart for other sizes of Chatsworth "Universal
Cable Runway".

See 27.13.13 BACKBONE COPPER (Riser)

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072
Chemistry Addition - Research Labs Renovation

Bloomington, Indiana

IU Project No. 20240397 / BSA Project No. 00360477

Category 3 Copper Backbone Cable OFS Type CMP, #24 AWG, twisted pair, solid copper
Category 3, suitable for placement in a plenum Category 3 Copper Backbone Cable Belden Corporation equivalent
Category 3 Copper Backbone Cable General Cable, Guardian Products, equivalent Category 3
Copper Backbone Cable Mohawk Wire and Cable Corporation equivalent Category 3 Copper
Backbone Cable Commscope, General Instrument, equivalent
Riser Cable to Patch Panel Tie Cable Type CMP 25-pair amphenol style cable, #24 AWG twisted pair, solid copper
Category 3

See 27.13.23 BACKBONE FIBER

Sumitomo 12 fiber 50 micron Multimode OM4 Plenum Riser Cables, MPO/MPO
CB-4012IUUXYY020M-P1R Cable, pulling eye one end only, 20 meters CB-
4012IUUXYY030M-P1R Cable, pulling eye one end only, 30 meters CB-
4012IUUXYY040M-P1R Cable, pulling eye one end only, 40 meters CB-
4012IUUXYY050M-P1R Cable, pulling eye one end only, 50 meters CB-
4012IUUXYY060M-P1R Cable, pulling eye one end only, 60 meters CB-
4012IUUXYY070M-P1R Cable, pulling eye one end only, 70 meters CB-
4012IUUXYY080M-P1R Cable, pulling eye one end only, 80 meters CB-
4012IUUXYY090M-P1R Cable, pulling eye one end only, 90 meters CB-
4012IUUXYY100M-P1R Cable, pulling eye one end only, 100 meters CB-
4012IUUXYY110M-P1R Cable, pulling eye one end only, 110 meters CB-
4012IUUXYY120M-P1R Cable, pulling eye one end only, 120 meters CB-
4012IUUXYY150M-P1R Cable, pulling eye one end only, 150 meters CB-
4012IUUXYY160M-P1R Cable, pulling eye one end only, 160 meters CB-
4012IUUXYY275M-XXA Cable, pulling eye one end only, 275 meters

Sumitomo 12 fiber Singlemode Plenum Riser Cables, MPO/MPO
CB-9012IUUXYY020M-P1R Cable, pulling eye one end only, 20 meters CB-
9012IUUXYY030M-P1R Cable, pulling eye one end only, 30 meters CB-
9012IUUXYY040M-P1R Cable, pulling eye one end only, 40 meters CB-
9012IUUXYY050M-P1R Cable, pulling eye one end only, 50 meters CB-
9012IUUXYY060M-P1R Cable, pulling eye one end only, 60 meters CB-
9012IUUXYY070M-P1R Cable, pulling eye one end only, 70 meters CB-
9012IUUXYY080M-P1R Cable, pulling eye one end only, 80 meters CB-
9012IUUXYY090M-P1R Cable, pulling eye one end only, 90 meters CB-
9012IUUXYY100M-P1R Cable, pulling eye one end only, 100 meters CB-
9012IUUXYY110M-P1R Cable, pulling eye one end only, 110 meters CB-
9012IUUXYY120M-P1R Cable, pulling eye one end only, 120 meters CB-
9012IUUXYY150M-P1R Cable, pulling eye one end only, 150 meters CB-
9012IUUXYY160M-P1R Cable, pulling eye one end only, 160 meters CB-
9012IUUXYY275M-XXA Cable, pulling eye one end only, 275 meters

See 27.13.33 BACKBONE COAX

CATV Coaxial Backbone Cable CommScope Video Series CATVP RG11, Plenum Rated
or Belden or General Cable equivalent CATV
Coaxial Backbone Cable CommScope 2287K, RG11, Plenum Rated
or Belden or General Cable equivalent
CATV Amplifier ACI Communications, Inc. MFTJ1/42PC419-1 with North American cord set

CATV Coupler Tru-Spec
CATV Coupler TVC
CATV Coupler Scientific Atlanta
Directional Tap, 4 port Blonder Tongue SRT-4A, 5-1000 Mhz
Directional Tap, 8 port Blonder Tongue SRT-8A, 5-1000 Mhz
3-way Splitter Blonder Tongue SXRS-3, 5-1000 Mhz

See 27.15.13 HORIZONTAL COPPER CABLING

Horizontal Station Cable, 6A Plenum Superior Essex 10 Gain XP 6A Plenum P/N 6H-272-7B
Purple, .275 inches, bend radius 1.20 inches
Horizontal Station Cable, 6A Plenum General Genspeed 10UTP6A Plenum
P/N 7141825, Purple, .250 inches, bend radius 1.00 inches
Horizontal Station Cable, 6A Plenum Bertek LANmark-XTP 6A Plenum P/N 11085661
Violet, .275 inches, bend radius 1.12 inches
Horizontal Station Cable, 6A Plenum Belden 10GXS13 6A Plenum P/N 0071000 Violet,
.265 inches, bend radius 1.10 inches Horizontal
Station Cable, 6A Plenum Panduit PUP6AM04VL-UG 6A Plenum Violet,
.275 inches, bend radius 1.10 inches

For Outside Emergency Phones, and Conduits in Slab-On-Grade:

Horizontal Station Cable, 6A filled Superior Essex 04-001-A5 OSP BBDG Horizontal
Station Cable, 6A filled Superior Essex 04-001-A4 OSP BBDN

See 27.15.33 HORIZONTAL COAXIAL CABLING

RG-6 Coaxial Cable, Plenum RG-6 Quad-shield Plenum,
or Belden or General Instrument equivalent

See 27.15.43 INFORMATION OUTLET

Standard Information Outlet, Single Gang face

Double Gang Electrical Box 4"x4" minimum x 2-1/8" deep double gang box Mud Ring 4"
square Double Gang to Single Gang mud ring Faceplate Panduit CFPE4IWY
Executive Series, 4-port,
off-white faceplate
Jack module: Cat 6A Panduit CJ6X88TGVL TX6 PLUS, Violet
Blank module Panduit CMBIW-X Mini-Com blank module insert,
off-white

Standard Information Outlet, Double Gang face

Double Gang Electrical Box 4"x4" minimum x 2-1/8" deep double gang box Mud Ring 4"
square Double Gang mud ring

Faceplate Panduit CFPE10IW-2GY Executive Series, 4-port,
off-white
Jack module: Cat 6A Panduit CJ6X88TGVL TX6 PLUS, Violet
Blank module Panduit CMBIW-X Mini-Com blank module insert,
off-white

Wall Phone Outlet

Single Gang Electrical Box 4"x4" minimum x 2-1/8" deep double gang box Mud Ring 4"
square Double Gang to Single Gang mud ring Wall Plate Panduit
KWP6PY stainless steel plate
with Category 6 Keystone module
(see also below for Security Phone Wall Plate)

Wireless Access Point Outlet (WAP) – Ceiling Mount

Tile Ceiling Mount Oberon Model 1068-00 Aruba 315 Hard

Ceiling Mount..... Aruba AP-310-MNT-W3 Aruba 335/345 Hard Ceiling

Mount... Aruba AP-220-MNT-W3

Jack module: Cat 6A..... Panduit CJ6X88TGV L TX6 PLUS, Violet

Wireless Access Point Outlet (WAP) – Wall Mount

Double Gang Electrical Box 4"x4" minimum x 2-1/8" deep double gang box Mud Ring 4"

square Double Gang mud ring

Faceplate Panduit CFPL2IW-LY Executive Series, 2-port, Jack module: Cat

6A..... Panduit CJ6X88TGV L TX6 PLUS, Violet

Biscuit Jack

Interior Wall Security Phone

Wall Phone Plate Hubbell P630S

Wall Phone Set Cortelco Trendline 815047-VOE-21F Top of mounted set must be
below 48" aff;

therefore the installed top of the Wall Phone Plate should not be higher than 45" aff.

27.08.00 COMMISSIONING

27.10.00 STRUCTURED CABLING

27.11.00 EQUIPMENT ROOM FITTINGS

27.11.03 WALLS

1. All walls shall be covered with 4' x 8' x 3/4" plywood, mounted 0'-6" above the finished floor with the 8'- 0" dimension vertical.

1.1. Backboards shall either be painted with two (2) coats of fire retardant paint on all sides, or fire-retardant treated and painted.

1.2. Backboard paint color shall be a light gray / off-white.

27.11.13 ENTRANCE PROTECTION

1. Entrance cable protection shall be provided by the installer of outside plant cables in accordance with all applicable codes and standards.
 - 1.1 On the IUB and IUPUI campuses, UITs provides outside plant cables and terminations to the building IDF-1 (MDF).
 - 1.1.1. Any station cable which leaves the envelope of the building must be OutSide Plant rated and be electrically protected.
 - 1.2 On the regional campuses, outside plant facilities must be included in the project; the work must be performed by a qualified telecommunications contractor.

27.11.16 CABINETS, RACKS, FRAMES and ENCLOSURES

1. Equipment Racks

- 1.1. The equipment rack shall be installed in the Telecommunication Equipment Rooms (IDFs) according to layout and communication media requirements
- 1.2. Telecommunication Equipment Room (IDF) layouts shall be coordinated with the appropriate University Information Technology Services representative
- 1.3 The rack shall be anchored to the floor and braced overhead with ladder racking and grounded to the ground busbar location in the IDF with a #6 solid or stranded ground wire.



2. Wire management

- 2.1. Vertical: Open ends of racks shall have 12" vertical wire management with hinged doors on the front.
- 2.2. Between each of multiple racks use 12" a vertical wire manager with a hinged door on the front.
- 2.3. Horizontal: On the top and bottom of each rack, install one horizontal wire manager with covers.

27.11.19 TERMINATION BLOCKS and PATCH PANELS

1. Copper Equipment

1.1. Unshielded Twisted Pair Riser

- 1.1.1 Amphenol style cables shall be terminated on 110 type blocks with 110A wiring blocks.
- 1.1.2. Terminal blocks shall be located so as to be easily cross-connected to feeder pair and the voice cable stations and plugged into the analog voice patch panel.

1.2. Horizontal Cabling Patch Panels

- 1.2.1. Use Panduit modular 6 port face plate angled patch panels filled with yellow TX-6+ modules

1.2.2. Use a Panduit voice patch panel installed in the rack for analog voice with a 50 pin, 25 pair female amphenol connector

1.2.3. All patch panels, termination panels, and cable managers should be installed so that their fronts, and the front of the networking equipment later provided by owner, shall be visible from the telecommunications room open doorway.

2. Fiber Equipment

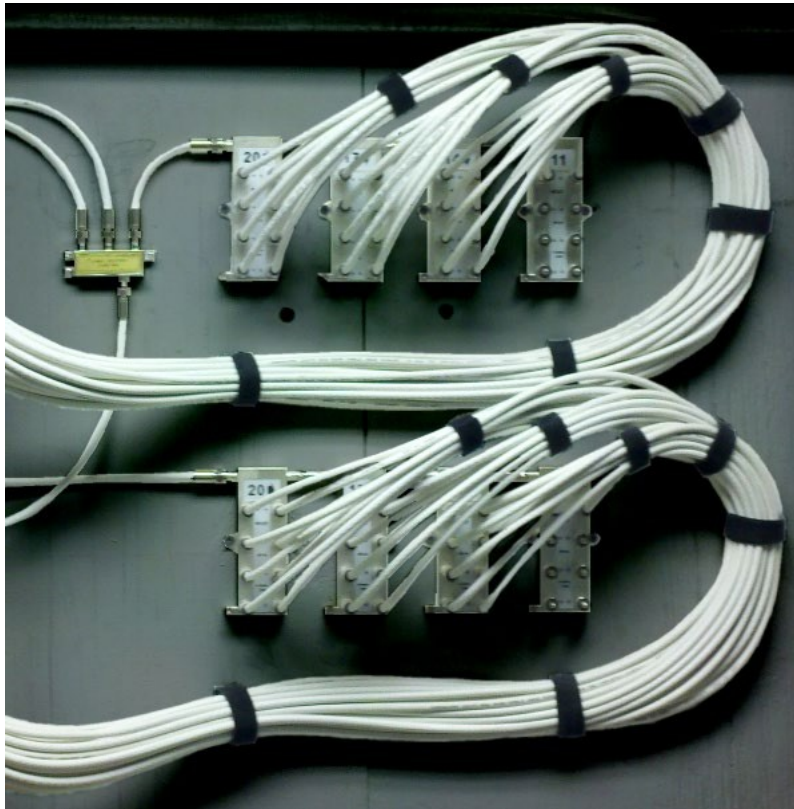
2.1. Use cable clamps, breakout kits, mounting bracket(s) and other miscellaneous hardware as necessary to complete a proper installation.

2.2. Breakout kits will be required to terminate all loose tube 250 micron fibers (outdoor rated cables).

2.2.1. NOT needed for 900 micron fiber.

3. Coaxial Equipment

3.1. Amplifiers, couplers, directional taps, splitters, and associated parts shall not be mounted in telecommunication rooms. Coaxial equipment shall be mounted on wall mounted plywood as noted on the prints and in following illustration.



27.11.23 CABLE MANAGEMENT and LADDER RACK

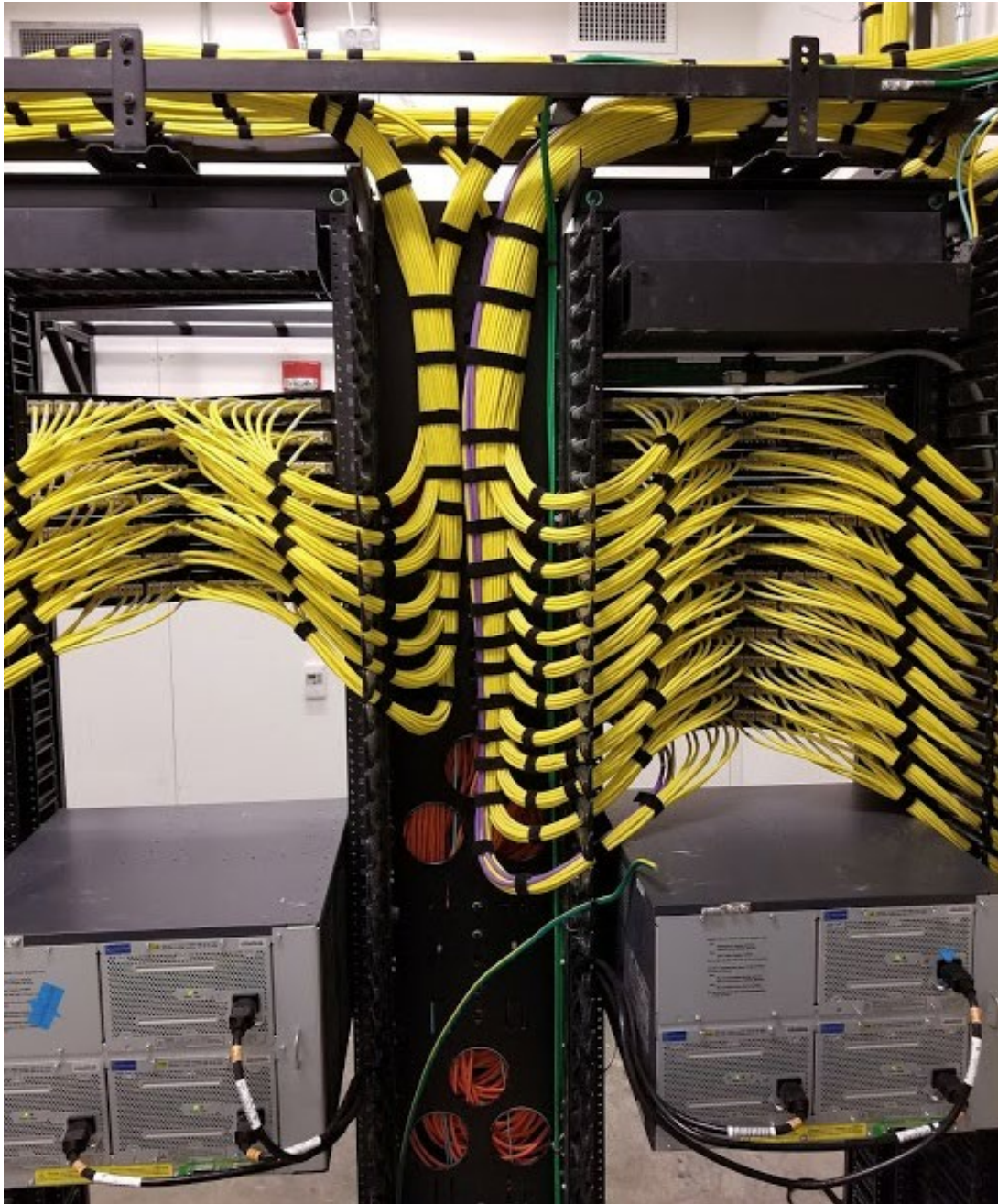
1. A minimum 18" ladder rack shall be installed from the top of and perpendicular to the equipment rack(s) to 4' x 8' wall mounted plywood board, as needed to stabilize equipment racks, and according to room

layout and field conditions. See also illustrations.

2. Bond all ladder rack segments and connect to telecom grounding bar with minimum #6 ground wire.
3. Transition station cables and bundles from room entrances to ladder rack with large radius bends (following illustration).
4. Preserve bundles as defined by conduit and cable tray entrances into the IDF room; do not combine station cable bundles as defined by entrances into IDF room into larger bundles. If exceptionally large bundles enter the IDF room by cable tray, divide into manageably sized bundles.
5. Use vertical ladder rack for distances greater than three (3) feet from conduit or cable tray to IDF ladder rack.
6. Neatly bundle station cables and secure bundles with Velcro tie wraps (following illustration).



7. Transition station cables and bundles from ladder rack to wire managers with large radius bends (following illustration).
8. Keep station cables and bundles to the side from which they transition. (following illustration) Eg, do not block wire manager by arcing cables from one side to the other. Maintain proper bend radius.
9. Preserve cable bundles; do not combine bundles.
10. Neatly bundle station cables and secure bundles with Velcro tie wraps (following illustration).

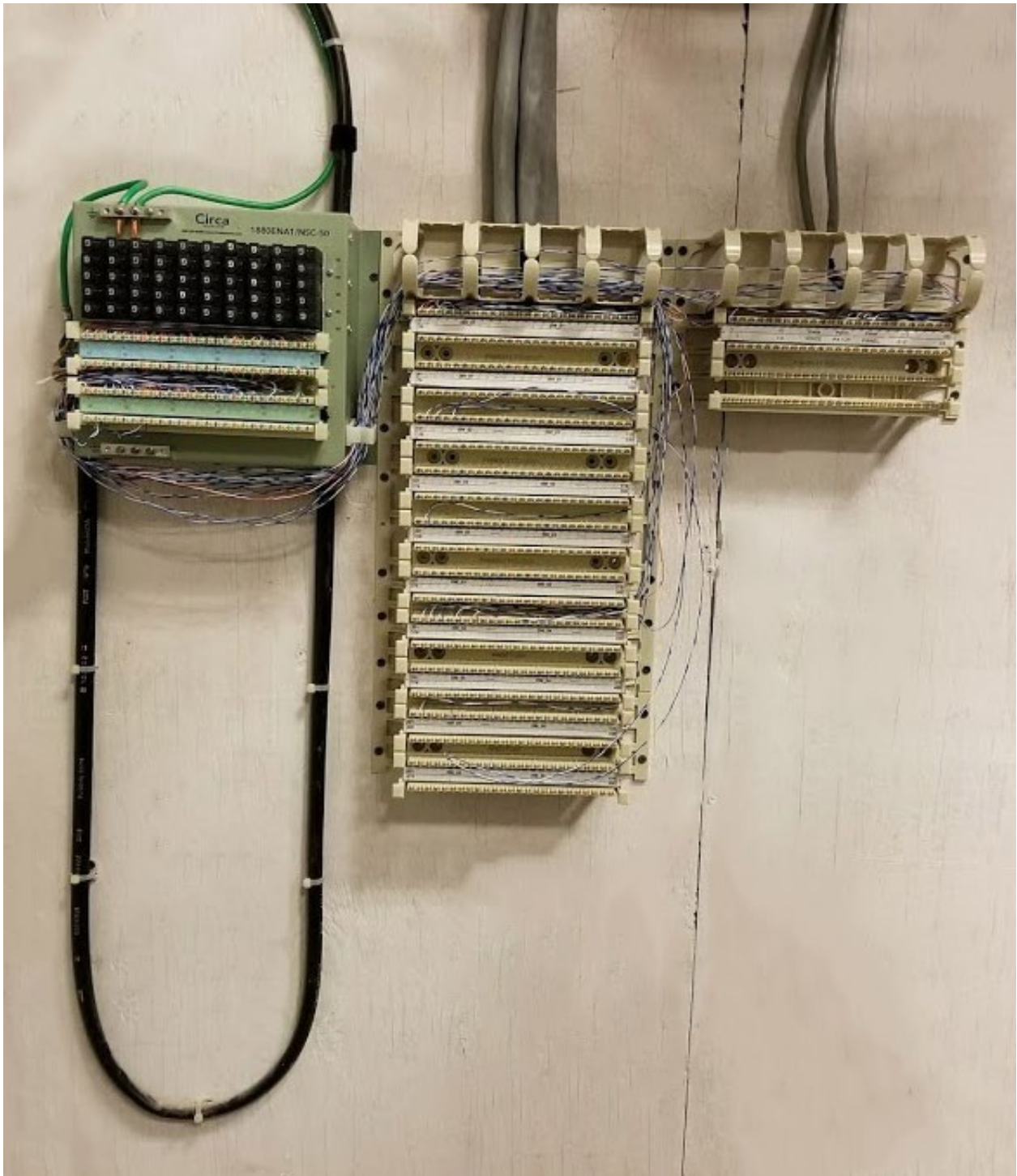


11. Mount top of protector block(s) and riser block jumper rings at 5 feet (60 inches). (following illustration)
12. Riser blocks and protector block must be mounted adjacent to one another.

BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072
Chemistry Addition - Research Labs Renovation

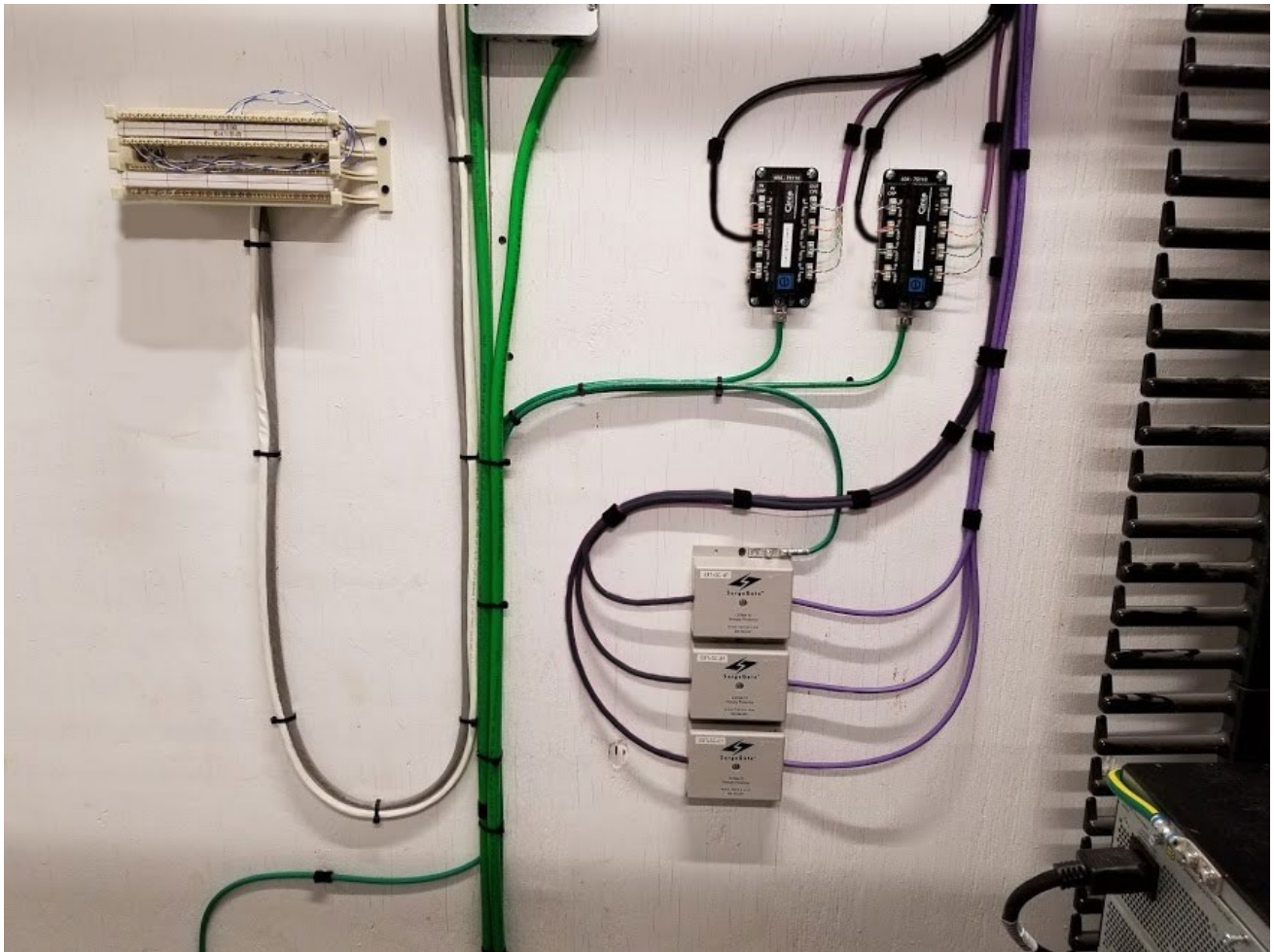
Bloomington, Indiana

IU Project No. 20240397 / BSA Project No. 00360477

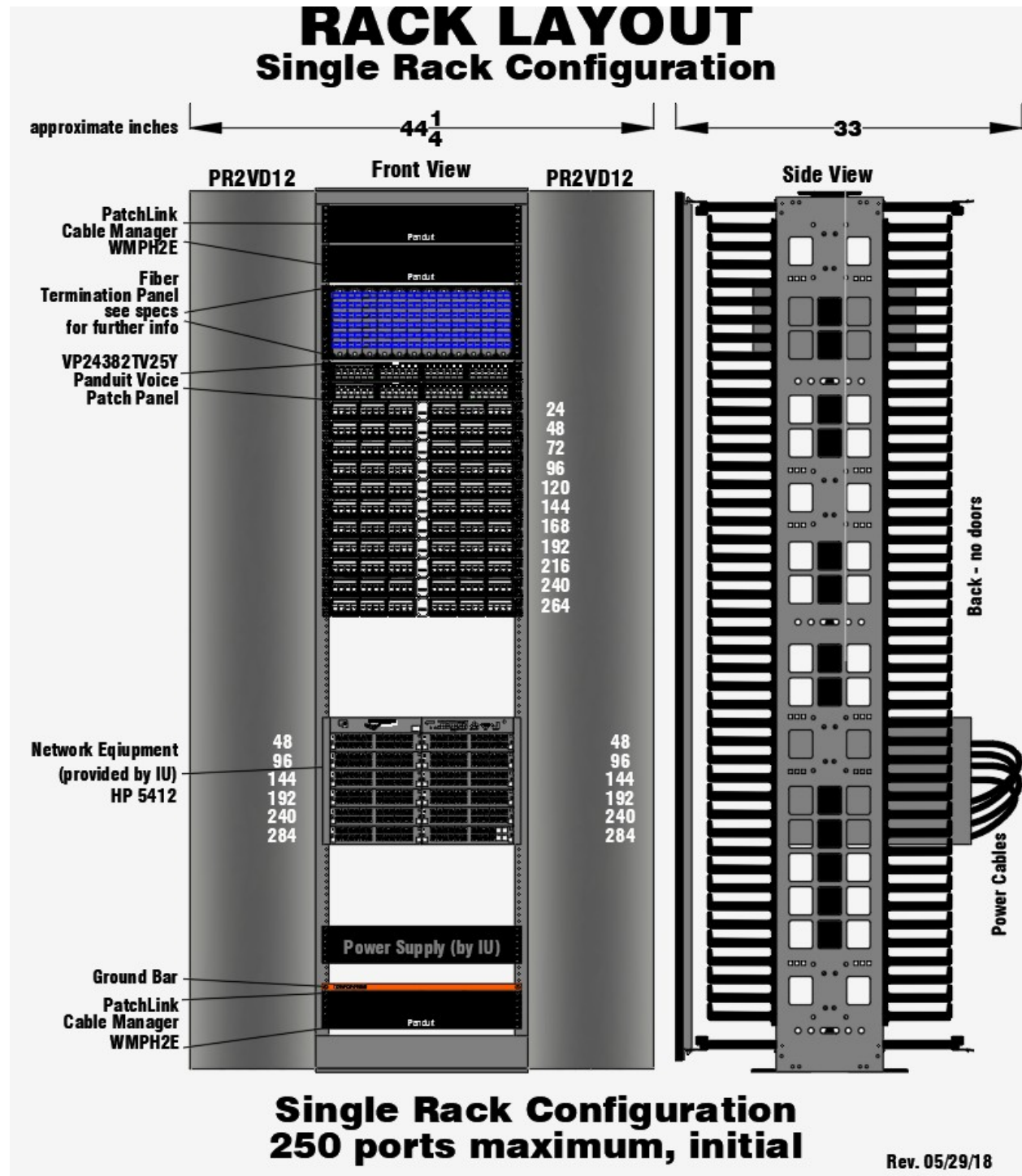


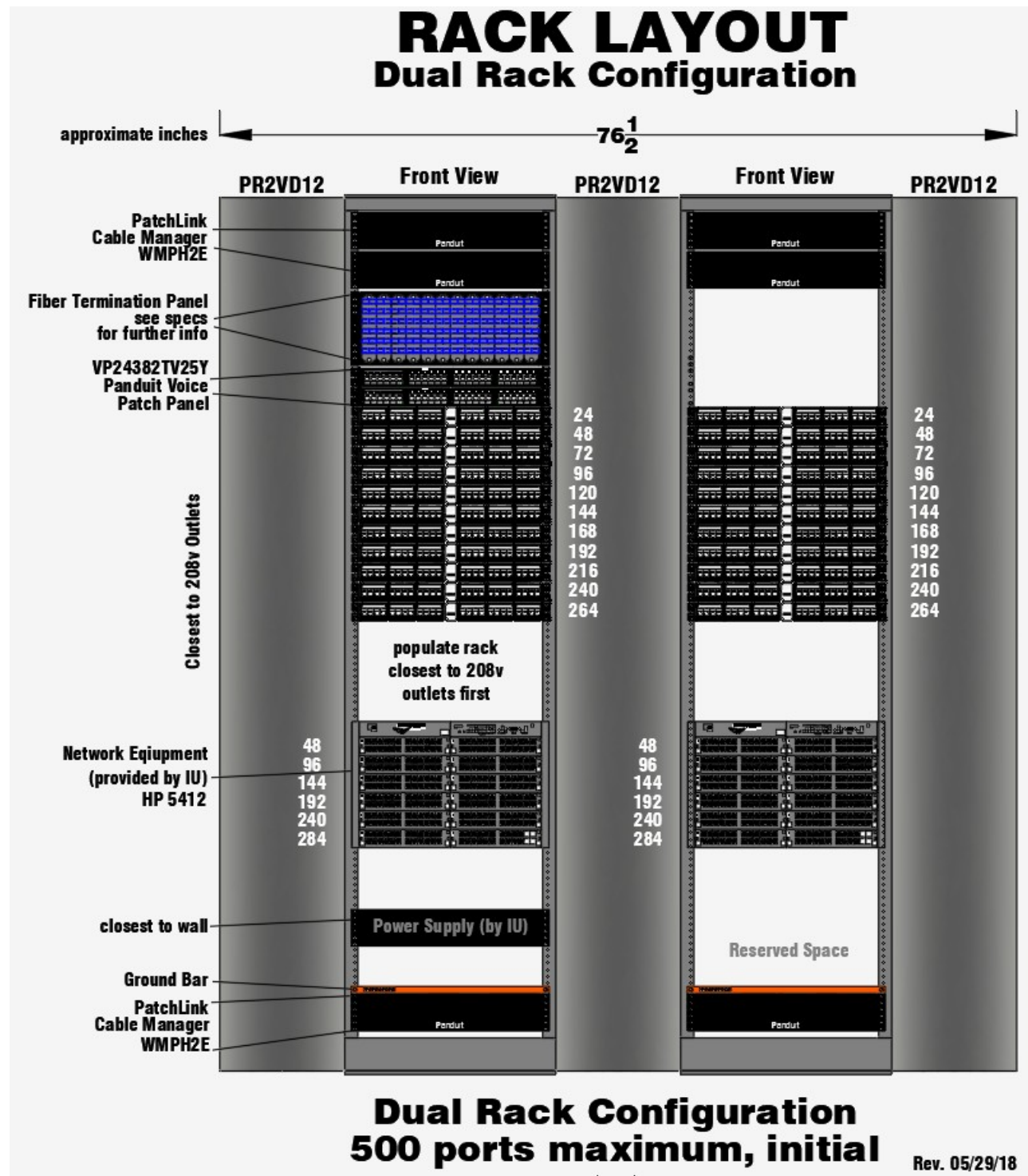
13. Mount 110 block for connections between riser cable and voice patch panel. (Left side of following illustration.) In MDF, this block should be physically separated from riser cable blocks next to outside plant protector block(s) .

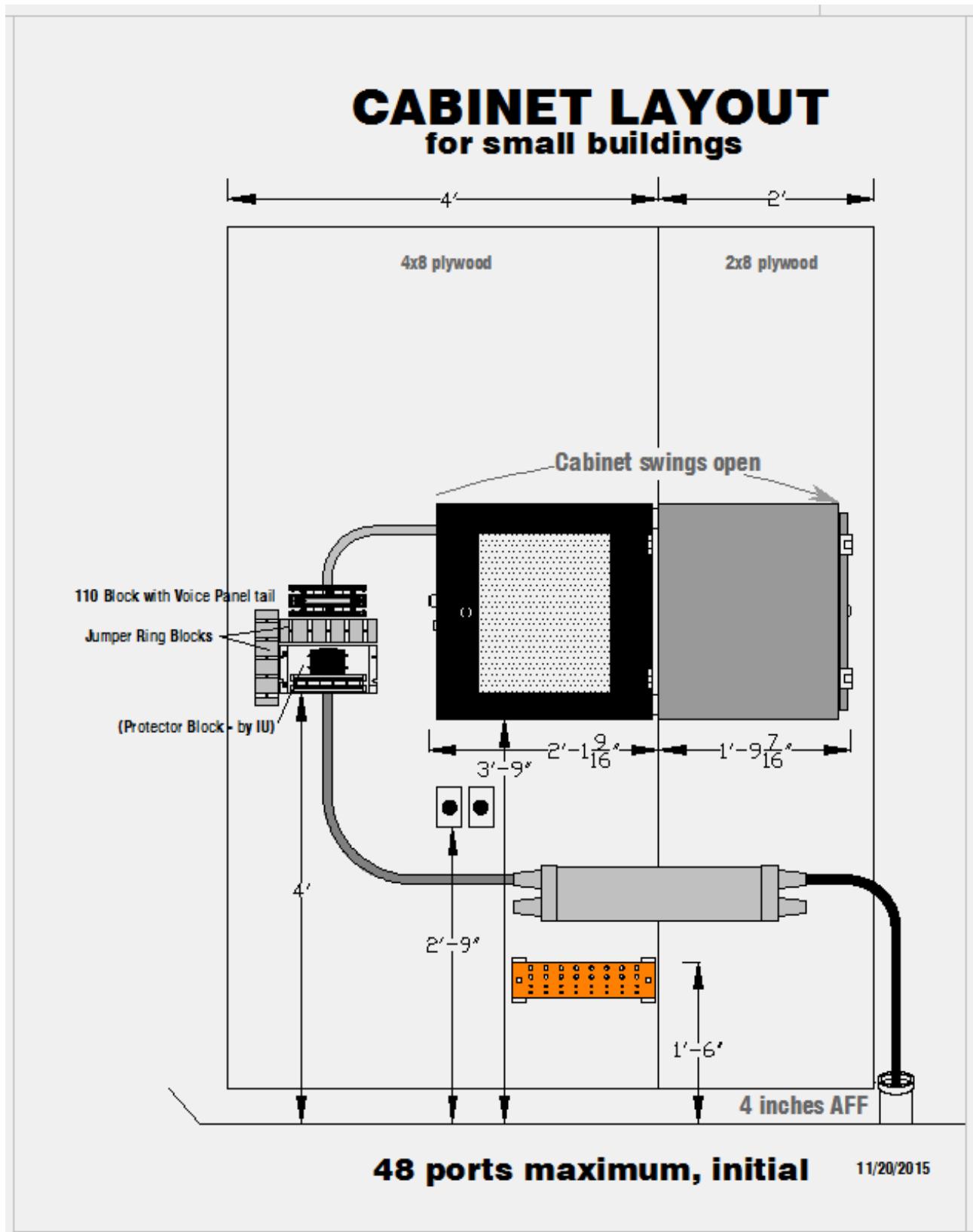
14. Mount 4-pair protector units for individual outdoor station cables in a configuration similar to below. Provide proper grounding from telecom grounding bus bar to each protector unit according to manufacturer's instructions.
15. Use only shielded station cable from outside mounted security phones and security cameras to the individual 4-pair protector unit(s) in accordance with NEC grounding practices for outside telecom cables entering a building envelope. Connect shields to the 4-pair protector unit grounding device according to manufacturer's instructions.
16. In all cases, housekeeping counts. Use tie wraps and Velcro straps as necessary to provide neat, traceable and maintainable wire and cable paths.

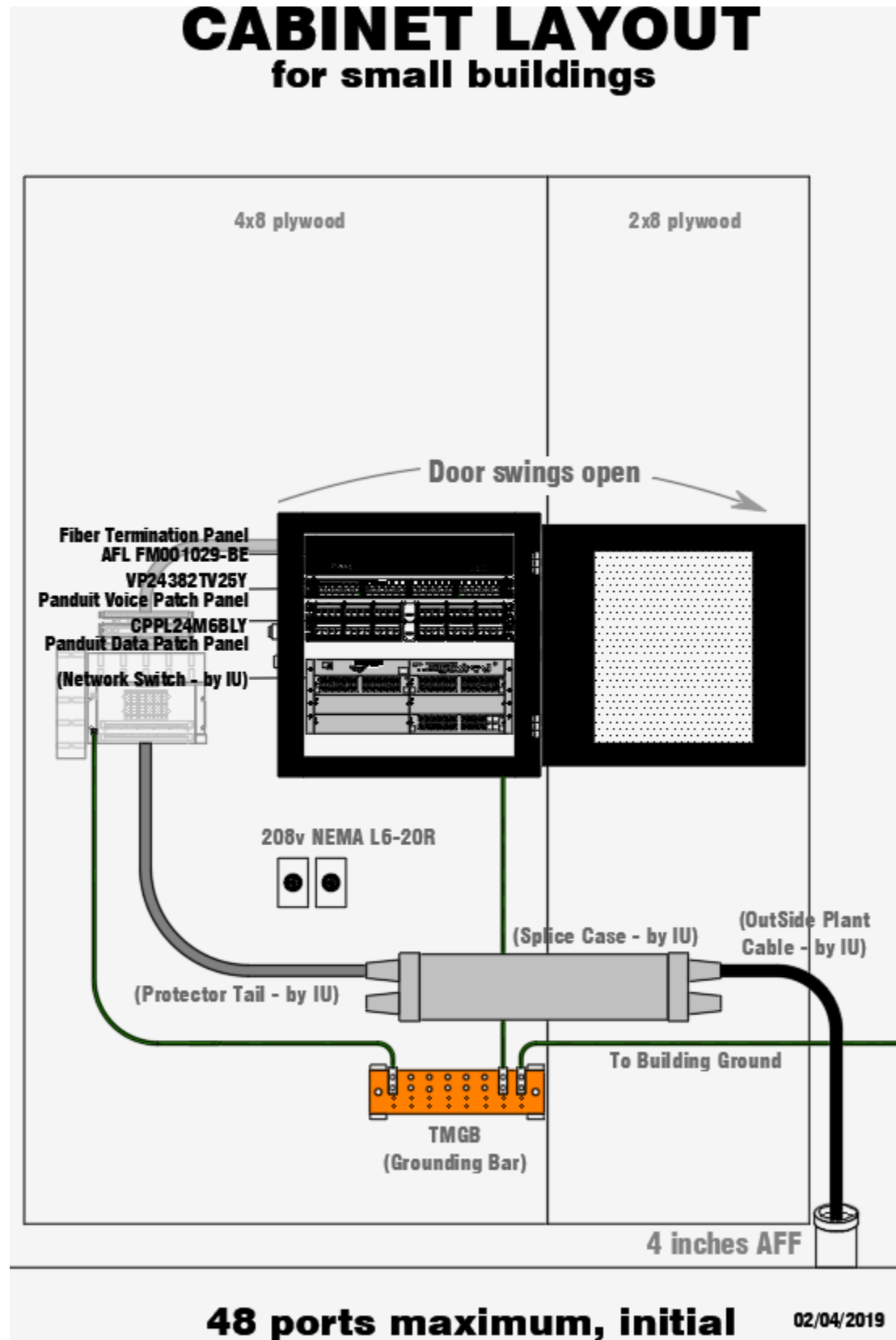


27.11.36 EQUIPMENT RACK LAYOUTS









BL000B - BL027 Swain West, BL070 Simon Hall, BL071 Chemistry, BL072
Chemistry Addition - Research Labs Renovation
Bloomington, Indiana
IU Project No. 20240397 / BSA Project No. 00360477

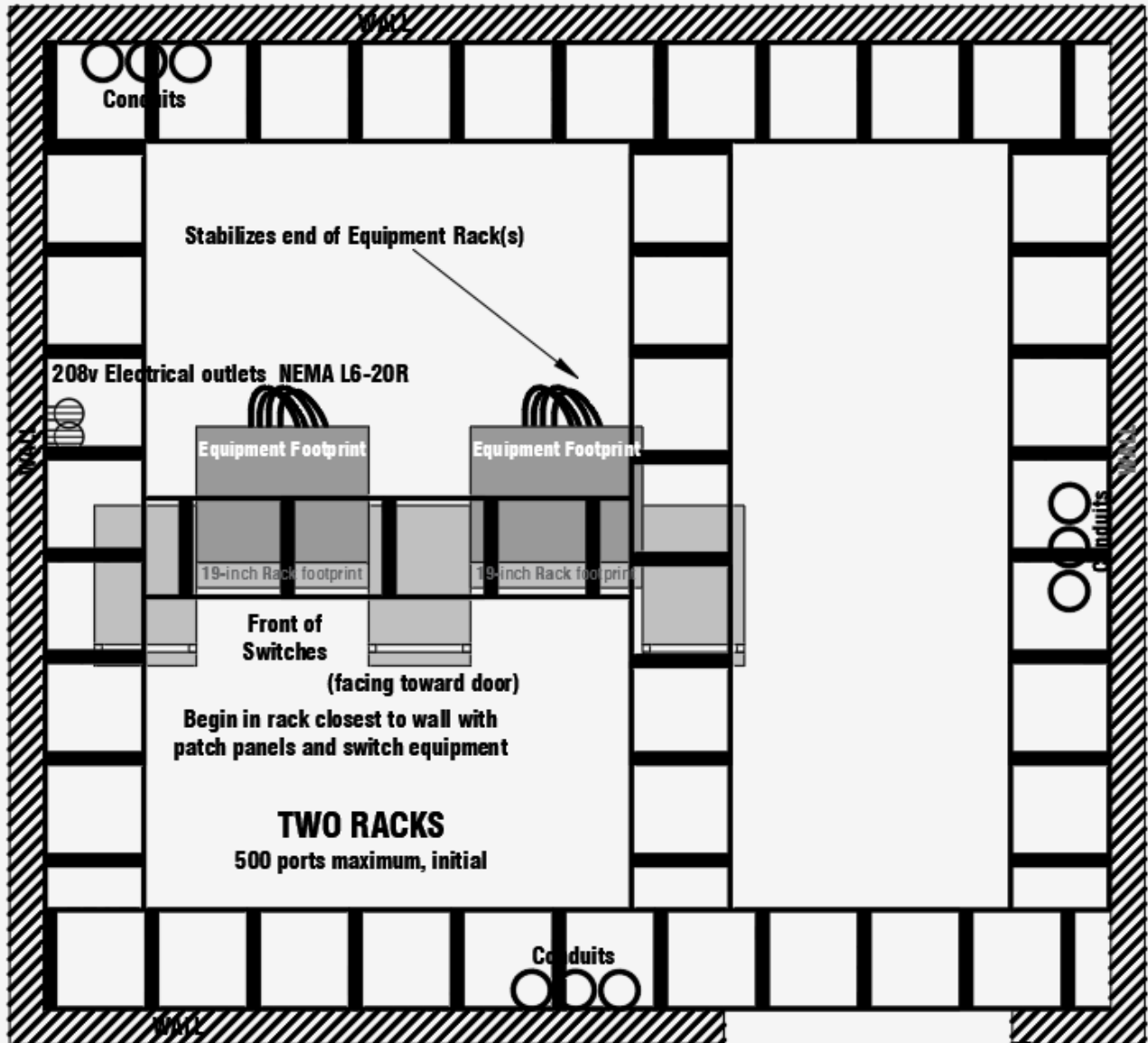
27.11.46 EQUIPMENT ROOM LAYOUT

IDF ROOM - LADDER RACK LAYOUT

Chatsworth Universal Cable Runway

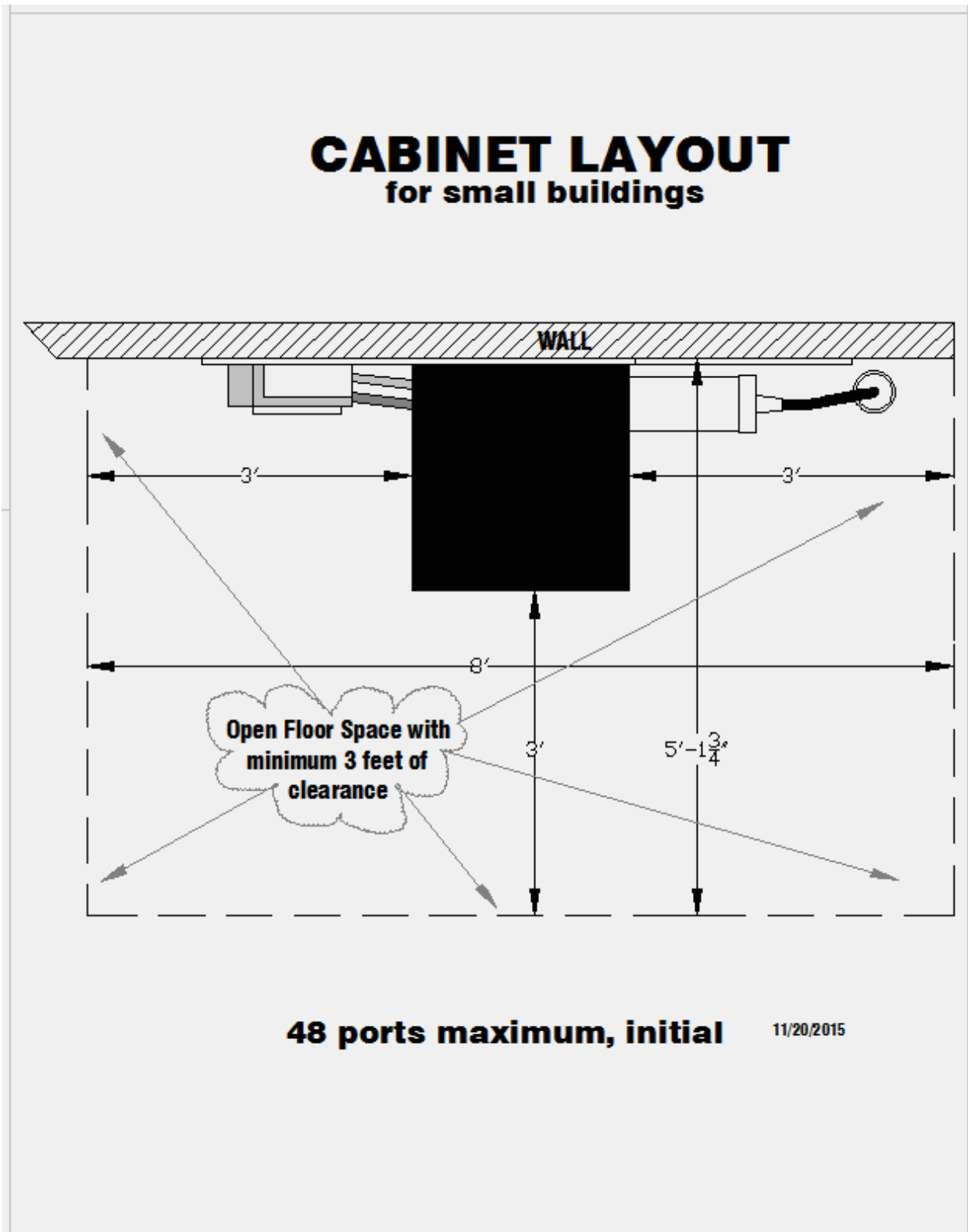
Chatsworth 10250-7xx **

**** where xx = 12, 15, 18, 24, etc.**



DESIGN NOTE: Section of ladder rack must be sized according to maximum cables. For example, if each 12" wide section above will be full, then trays from outside the room coming in will need to be a minimum total 36" of tray width.

02/16/2018 gls



27.12.00 TRANSMISSION MEDIA

1. General: Provide telecommunication transmission media of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for applications indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
2. Cable Labeling: The National Electrical Code (NEC) requirements dictate that telecommunication cables used within a building are classified as to their use and smoke and flame requirements. Underwriters Laboratories (UL) provides certification that a cable meets the NEC requirements.
3. All cables shall be clearly marked with the proper NEC classification as follows:

RISER CABLES . CABLE TYPE NEC
CLASSIFICATION CODES
Fiber Optic OFNP, OFNR
Copper UTP CMR & CMP, Category 3
Coaxial CL2R & CL2P, CATVR & CATVP

HORIZONTAL CABLES . CABLE TYPE
NEC CLASSIFICATION CODES
Fiber Optic OFN, OFNR & OFNP
Copper UTP CMG, CMR & CMP, Category 6A Coaxial
CL2, CL2R & CL2P

27.13.00 BACKBONE CABLING

27.13.13 COPPER BACKBONE CABLING

1. Terminating blocks mounted to the wall.
2. Copper backbone cables shall be extended to the equipment rack with 25 pair male amphenol style cables, terminated at the wall on 110 blocks on one end, with the amphenol end plugged into the analog voice patch panels.
3. Cable pairs and 25-pair binder groups shall be cut down in standard color code order.
4. UTP riser cable will have cable ID and pair count clearly marked on building equipment room and punch down blocks.
 - 4.1. Copper backbone cabling will be labeled in both the building telecommunications equipment room and the floor telecommunications equipment rooms.
 - 4.2. Cable ID's will be building number + an underscore + an incremental two digit cable number.
 - 4.2.1. For example, the cable to IDF-2 would be 023_01, while the cable to IDF-3 would be 023_02.
 - 4.3. Counts shall start from the lowest IDF number and increment with IDF numbers.
 - 4.3.1. For example, the cable to IDF-2 would count 023_01, 1-50, while the cable to IDF-3 would count 023_02, 51-100.
 - 4.4. All labeling must be approved by the appropriate IU UITs personnel.

27.13.13.23 Testing of Copper Backbone Cabling

1. Perform visual inspection to ensure that all cables are terminated on the punch down block in proper color code order.
2. Test all pairs for continuity and tip and ring polarity.
3. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA-568 specifications.
4. Bad pairs shall be limited to a maximum of 1% of the total number of pairs, and with a maximum of two (2) bad pairs per binder group.
5. Test results shall be posted to the University project management website, emailed to the appropriate UITs representative (depending on whether it is AV or telecom test results) in a timely fashion, and stored on a CD and delivered to the University Information Technology Services representative upon request.
6. Test results shall be verified by the designated University personnel as part of the *inspection* and acceptance procedure.

27.13.23 OPTICAL FIBER BACKBONE CABLING

1. Qualifications

- 1.1. Bidders will supply documentation of verified experience splicing the proposed type(s) and size(s) of cable, splice cases, and where applicable cutting over live fiber circuits with minimal down time.

2. Cable Installation

- 2.1. Install FO cables and devices in accordance with industry standards and manufactures written instructions.

2.1.1 Fiber riser cables must be separated from horizontal station wires and station wire bundles.

2.1.2. Fiber riser cables must be kept to the side of cable trays and not be placed under station wires.

2.2. Install fiber optic cable without damage to fibers, cladding, or jacket.

2.2.1. Ensure that media manufactures recommended pulling tensions are not exceeded.

2.3. Do not bend cables to smaller radii than minimums recommended by manufacturer.

2.4. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway.

2.4.1. Install FO cable simultaneously where more than one cable is being installed in the same raceway.

2.5. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap.

2.6. NO splices are allowed. Cable runs to be continuous.

2.7. Install a spare fiber loop of between 50 and 100 feet in each IDF for each fiber cable.

2.7.1. Secure fiber loop(s) in a location which will not interfere with the installation of other cables, conduits and devices in the IDF room.

2.7.2. For outside plant fibers, install spare fiber loops in every third manhole.

2.8. Provide grounding connections for FO cable and other system components as required by

specifications and applicable codes and regulations, according to manufacturer's written instructions.

2.9. Fiber optic cable will have cable ID and strand count clearly marked on the fiber cabinet in the IDF, on the cable in the fiber cabinet, and on at least one visible point along its racking route within the IDF.

2.9.1. Outside plant fiber optic cable shall be labeled likewise in every manhole with stamped stainless steel tags.

27.13.23.13 Splicing and Terminations

1. Execution

1.1. The Contractor is responsible for performing work in compliance with OSHA 1910.146 (Permit Required Confined Spaces) and OSHA 1910.268 (Telecommunication Installation Practices).

1.2. All fiber splicing will be done in a well-lighted secured controlled environment (climate controlled splicing trailer or vehicle built specifically for fiber cable splicing, IDF closet or approved room, or equivalent wherein dust or and other contaminants are minimized), with splice case and cables properly secured.

1.2.1. Splicing on outside plant fiber cables should not occur in manholes unless no other approved option is possible, and then requires specific approval and monitoring by appropriate UITS personnel.

1.2.2. In any case, splicing location must be away from electrical or other utility dangers and clear of vehicular and pedestrian traffic.

1.3. Perform all work according to University plans and specifications, manufacturers' specifications and recommended practices where given, and best industry practices otherwise, including workspace and fiber hygiene.

1.4. Provide termination of cables.

1.4.1. Use AFL fiber optic connectors on singlemode cables.

1.4.2. Use preterminated MTP/MPO connectors on 50 micron multimode cables with pre-connectorized modules with and AFL cabinets.

27.13.23.23 Testing of Fiber Cables

1. General

1.1. Maintenance of working circuits is critical. Cutover of live circuits require prior approval of UITS Change management as described in "27.04.40 SEQUENCING and SCHEDULING".

1.2. It will be the contractor's responsibility to provide the test equipment necessary and document the campus telecommunication coordinator the test equipment available for testing and the last date of certification.

1.3. Cables will have connectors installed on fiber cables prior to testing.

1.4. Tests shall be performed on inter-building and riser fiber cables.

1.4. Testing equipment:

1.4.1. Continuity tester

1.4.2. Visible fault detector

1.4.3. Power meter and light source

1.4.4. OTDR (Optical Time Domain Reflectometer)

1.4.5 Appropriate types of fiber jumpers

1.4.6. Equipment for two testers to communicate

1.4.7. Fluke DSP 4000 or equivalent.

1.4.8. Other equipment as approved by designated University personnel and as required to complete the testing to the satisfaction of the University

1.5. Prior to usage, test equipment and components in accordance with manufactures published test procedures.

1.6. All fibers will be tested bi-directionally per TIA-526-7 (singlemode) and TIA-526-14 method A-2 (multimode).

1.7. Bi-directional attenuation figures in decibel (dB) will be documented.

1.7.1. Before testing, verify with the University Information Technologies representative if raw or referenced readings are preferred.

1.8. All strands shall test good and meet current ANSI/TIA-568 specifications. Dark fibers and excessive attenuation due to breaks, bends, bad splices, defective connectors and bad installation practices will not be accepted and must be corrected.

1.9. Replacement fiber cables shall be subject to tests and criteria as described in this document.

1.10. All fiber cables shall have NO bad fibers. Fiber cables tested to have bad fibers, and determined to be non-repairable by practices acceptable to the University, shall be replaced at no additional cost to the University.

1.11. Any and all measures taken to correct unacceptable test results will be recorded, along with loss measurements taken before and after corrective measures.

1.12. Documentation will include cable ID, from and to points, strand ID, bi-directional attenuation figures in dB, per TIA Method A-2.

1.13. Use of an OTDR may require that a "launch reel" be used to overcome the OTDR's dead zone, if needed for fault location if the bi-directional tests fail.

1.14. Fiber jumpers used with the OTDR, light source and power meter must be of the same size and type of the fiber being tested.

1.15. Clean all connections according industry recommended practices each time when installing connectors for testing and circuit connections.

1.16. Fiber jumpers used with the light source and power meters shall be zeroed out by attaching the jumper from the light source via a coupler to the jumper from the power meter.

1.16.1. This reading noted, will become the reference level to obtain a true attenuation reading (some power meters can be zeroed to allow reading the attenuation level direct).

1.16.2. TIA-526-7 and TIA-526-14 Method A-2 should be used to zero OLTS.

2. Loss Budgets

2.1. Average splice loss shall not exceed 0.35 dB attenuation for multi-mode, 0.25 dB attenuation for

single mode, measured from both directions.

2.2. No individual splice, multimode or single mode, shall exceed 0.50 dB attenuation, measured from both directions.

2.3. No termination shall exceed 0.40 dB attenuation for multimode, 0.30 dB attenuation for single mode.

d. No single mode OSP fiber shall exceed 0.000091436 dB attenuation per foot at 1550 nm. (0.25 dB attenuation per kilometer at 1550 nm).

2.4. Acceptable maximum allowable attenuation per spliced and terminated fiber will be determined by the following formula:

$$\text{MAX} = (\text{S} * \text{MS}) + (\text{E} * \text{ME}) + (\text{F} * \text{MF})$$

Where S = number of splices in fiber between end termination points

MS = dB maximum average allowable attenuation per splice

E = number of endpoint terminations (namely, 2)

ME = dB maximum allowable attenuation per endpoint termination

F = number of feet of fiber from endpoint termination to endpoint termination

MF = maximum allowable fiber attenuation per foot of fiber

Manufacturer's specifications (converted from dB/km by formula (dB per km / 3280.8))

3. Riser Fiber Cable Testing

3.1. Test multimode riser fiber at 850 nm and 1300 nm in both directions.

3.2. Test singlemode riser fiber at 1310 nm and 1550 nm in both directions is to be used.

3.3. No multimode riser fiber shall exceed 0.00021336 dB attenuation per foot at 1300 nm, 400 Mhz bandwidth. (0.70 dB attenuation per kilometer at 1300 nm, 400 Mhz bandwidth).

4. Entrance / Outside Plant Fiber Cable Testing

4.1. Test entrance fiber with an OLTS per TIA-526-7 method A-2, Option 1.

4.1.1. Test with an optical time domain reflectometer (OTDR) if needed per Option 2.

4.1.2. ORL should be -30 dB or higher.

4.2. Test singlemode entrance fiber at 1310 nm and 1550.

4.3. Test cable segments for faulty connectors and terminations, and for the integrity of the cable and its component parts.

4.4. Replace malfunctioning of damaged items with new materials, then retest until satisfactory performance is achieved. Test cable in both directions using the wavelengths described above.

27.13.33 COAXIAL BACKBONE CABLING

1. Design Specifications for Campus Cable Distribution System

Cable specifications Cable must be 100% shielded

Cable testing Cable must be 100% sweep tested and certified System frequency response 50 MHz - 1 GHz (Forward)

5 MHz - 42 MHz (Reverse)

System tilt 10 dbmv MAXIMUM

Maximum system level +40 dbmv at visual carrier, aural carrier shall be – 10 to -
17 - 6 dbmv in respect to visual carrier
Signal leakage Maximum signal leakage from the system shall not exceed
-40 dbmv at CATV channel 'A' (121.25 MHz), and shall
not exceed -53 dbmv at CATV channel 'W' (295.25 MHz)
Spurious output Spurious output of modulators/processors shall not exceed
-70 dbmv
System carrier to noise Shall exceed -54 dbmv at last tap
System operating range System shall perform as specified at temperatures 120°F
between 32°F
Hum to Noise System hum and noise shall exceed -50 dbmv at all points
Field rate sync division 5% maximum (FCC requirement)
Cross modulation -70 dbmv on fully loaded system
K-factor 2% or better
Adjacent carriers Adjacent channel carriers shall be within 2 dbmv
Receive outlet level +6 dbmv, +4 dbmv -3 dbmv
Return outlet level +10 dbmv, +15 dbmv -0 dbmv at the "head-end" equipment with signal
injected by modulator (+60 dbmv,
+0 dbmv -45 dbmv adjustable) located in technology
equipment.

2. Labeling of all coaxial cables will have the building equipment room and floor equipment room ends
clearly marked with the cable ID number.

3. Testing of coaxial cables

- 3.1. Cables will have connectors installed on ends prior to testing.
- 3.2. Cable must be 100% sweep tested and CERTIFIED to meet with CATV standards.
- 3.3. Frequency response from 50 MHz to 1 GHz will be measured and shall indicate no greater than 7 dbmv
system tilt.
- 3.4. Attenuation will be measured end to end using 150 MHz as a test signal and attenuation will be
documented in dbmv.
- 3.5. Documentation will include cable ID, from and to points, frequency response, attenuation figures and
as built information.

27.15.00 HORIZONTAL CABLING

27.15.00.23 COMMUNICATIONS AUDIO-VISUAL HORIZONTAL CABLING

See following addenda

27.15.16 VOICE COMMUNICATIONS HORIZONTAL CABLING

- 1. All telecommunications horizontal copper cabling materials and installation shall be data grade as
described in 27.15.19 and elsewhere, and shall NOT be referenced as "Voice" cable or wire.

27.15.19 DATA COMMUNICATIONS COPPER HORIZONTAL CABLING

- 1. Before the installation of Horizontal Cabling will be allowed to begin, the telecommunications
subcontractor must provide a mock-up of the labeling and wiring to a sample face-plate and patch

panel.

1.1. The mock-ups must be reviewed by an appropriate representative of UITS and approved prior to performing any final wiring required by the project documents.

2. Installation of Horizontal Copper Cabling

2.1. 4-pair UTP cables should withstand 25 foot-pounds of pulling pressure. This number shall be verified by the wire manufacturer.

2.1.1. Maximum cable length is limited to 90 meters (295 feet) from the jack to the patch panels.

2.1.2. Comply with ANSI/TIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.

2.1.3. The Contractor shall replace any damaged cable at no expense to the University. No repair will be allowed on damaged cables.

2.2. Cabling shall be terminated at the station jack and at the equipment room as indicated in ANSI/TIA-568, wiring configuration T568A.

2.2.1. The modular faceplate at the user end shall be equipped with inserts for communication services as indicated on plans.

2.2.2. Station cable in the IDF shall be terminated on Category 6A patch panels located in the equipment racks.

2.2.3. The minimum bend radius of Category 6A UTP cable shall not be smaller than the manufacturer's recommended minimum at any time during installation or after completion, and shall not cause the cable jacket to buckle.

2.2.4. Station cables supported by j-hooks shall have no more than 12 inches of sag between j-hooks.

2.2.5. Route cables from the back of the patch panel through its coupler openings and loosely attach them to the wire manager with Velcro cable ties, leaving enough slack for re-termination at a future date.

2.2.6. Remove only as much jacketing as needed to terminate properly to the connecting hardware, keeping the amount of jacketing removed to an absolute minimum.

2.2.7. Do not untwist pairs more than 0.5 inches.

2.2.8. Visually *inspect* cable pairs for bare wire and other defects before terminating wires.

2.2.9. Once all of the cables have been terminated, dress the cable slack behind the panel with Velcro tie wraps tightened to a snug but not compressing fit.

2.3. Telecommunication cabling for elevator emergency phones shall be provided as follows:

2.3.1. Cabling for the elevator telephone to the elevator control room is by the elevator installer.

2.3.2. Cabling from the elevator control room to the telecommunication equipment room is by the electrical contractor.

2.3.2.1. Jack must be mounted adjacent to, but outside of the elevator electrical panel.

2.3.3. The electrical contractor shall notify campus personnel of the elevator service date.

2.3.3.1. This notification for request of services shall be provided no fewer than 21 days prior to service.

3. Testing of Horizontal Copper Cabling

3.1. Perform visual inspection to ensure that all cables are terminated on the eight position station jacks on both ends in proper color code order.

3.2. All station cables attached between information outlets and floor equipment room patch panels will be link tested with a cable analyzer to ensure compliance with current ANSI/TIA-568.

3.3. All pairs shall test good and meet Category 6A parameters for the respective type of cable.

3.3.1. Open, split, miss-terminated pairs, deviations from the manufacturer's installation specifications,

defective connections and bad installation practices will not be accepted and must be corrected.

3.4. Test 100% of station wire in both directions with a certified handheld tester appropriate testing Category 6A installations, such as the Fluke OmniScanner or the Fluke DSP 4000 and other test equipment as necessary to assure proper termination sequences, continuity, and Category 6A compliance. Station wire shall have NO bad pairs.

3.5. When all station wire is determined to be acceptable, University Information Technology Services will spot test the plant using a certified handheld tester, such as the Fluke OmniScanner or Fluke DSP 4000.

3.6. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA-568 specifications.

3.7. The approved handheld tester will have the capability to be programmed with current Category 6A requirements as specified in ANSI/TIA-568 standards.

3.8. Documentation will include cable ID (same as jack ID) to be marked on the punch down blocks and patch panels in the telecommunication closet, station jack ID to be marked on the station jack and results of the testing done with the cable analyzer.

3.9. Analyzer documentation test result must be provided in the native format such as *.flw (not PDF) of the testing equipment used.

3.9.1. Results must be labeled using the information outlet labeling scheme for the project.

3.10. Test results shall be stored on a CD and delivered to the University Information Technology Services representative, or transmitted electronically to both the appropriate UITs representative and to the appropriate University Architect's Office representative.

3.11. Test results shall be verified by the designated University personnel as part of the inspection and acceptance procedure.

4. Submission of test results

4.1. In order to facilitate quicker turn-around for ordering and activating new information outlets in the building, the Telecommunications Subcontractor shall submit partial jack lists that are tested and approved rather than submitting the lists and test results of the entire building.

4.1.1. The details of how the partial lists are created will be determined in the field through coordination between the Telecommunications Subcontractor and the UITs Technical Staff.

4.1.2. As an example, test results may be submitted by IDF as work in an IDF is completed.

4.1.3. Special care must be taken to assure that telecommunications outlets for Fire Alarm systems and Elevator, which will be required for state inspections, be installed, tested and verified with sufficient lead times to meet the project construction and occupancy schedule.

27.15.23 OPTICAL FIBER HORIZONTAL CABLING

Not Applicable

27.15.33 COAXIAL HORIZONTAL CABLING

1. All coaxial cables will have the building equipment room and floor equipment room ends clearly marked with the cable ID number.

2. Testing of coaxial horizontal cables

2.1. Cables will have connectors installed on ends prior to testing.

2.2. Cable must be 100% sweep tested and CERTIFIED to meet with CATV standards.

2.3. Frequency response from 50 MHz to 1 GHz will be measured and shall indicate no greater than 7 dbmv system tilt.

2.4. Attenuation will be measured end to end using 150 MHz as a test signal and attenuation will be

documented in dbmv.

2.5. Documentation will include cable ID, from and to points, frequency response, attenuation figures and as built information.

27.15.43 FACEPLATES AND CONNECTORS

1. Termination equipment

1.1. All station cables in the IDF shall be terminated on rack mounted patch panels.

2. Information Outlet Rough-In

2.1. Standard Information Outlets (single gang or double gang) shall be located at the same height as 120 volt AC outlets (normally 18" above finished floor).

2.2. Wall mounted telephones require a double gang box with a single gang plaster ring, positioned 40" A.F.F. to the center of the outlet box.

2.3. Information Outlets above counter tops should be installed so that the center of the outlet box will be a minimum of 12" above the counter top.

2.3.1. A counter top with a splash back may require different outlet box locations.

2.4. Wall mounted telephones require a special wall telephone jack that provides mounting lugs for the telephone and an eight position jack.

2.5. Information Outlets for wall mounted wireless Access Points must be located to accommodate mounting the Access Point equipment, which is 8.0"(W) x 8.0"(D) x 2.2"(H), centered on the box.

2.6. No Information Outlet will be installed such that workstations or devices served from it cannot be reasonably reached by a 16 ft cord.

3. Finishing of Information Outlets

3.1. Information Outlet faceplates and jack modules must not be modified in any manner, including being painted.

3.2. Jack labeling must remain visible.

4. Labeling of Horizontal Copper Cabling

4.1. The telecommunications contractor's onsite representative(s) shall schedule a meeting with the UITs representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.

4.2. Information Outlet receptacles, cables, and terminations shall be labeled with a standard identification tag at both the Information Outlet and on the jackfields in the IDF/Wire Closet.

4.1.1. Tags shall be preprinted or computer printed with indelible waterproof ink and mechanically secured in a permanent fashion; for example, such as using an appropriate label maker with 3/8" tape.

4.1.2. Handwritten labels are NOT acceptable.

4.1.3. Labels shall be mounted in a manner which permits easy access and viewing.

4.1.4. The station cable serving each receptacle must be labeled at the room receptacle and the IDF rack.

4.3. Information Outlet receptacles in rooms are to be labeled -A through -ZZ in each room beginning with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room.

4.3.1. All labeling will be done in all capital letters.

4.3.2. For example, a jack labeled 246A-A would be because:

4.3.2.1. Room 246A is the room number

4.3.2.2. The Information Outlet designation is "A" (first receptacle in room from the left of the door) 4.3.2.3.. Station cables from a given room shall be terminated in sequential order, i.e. – 246A-A, 246A-B, 246A-C, 246A-D, etc. If double letters are needed, the progression would be –AA, -AB, AC, ... -AZ, -BA, - BB, etc.

4.4. Information Outlets for special purposes shall have a unique identifier listed with the jack ID.

4.4.1. The identifier shall be inserted into the Outlet ID, between the room number and the Outlet designator as indicated in following drawings.

4.4.2. Identifiers are listed below:

4.4.2.1. Building Automation "100+BA-A1" and "100+BA-A2"

4.4.2.2. Fire Panel "100+FP-A1" and "100+FP-A2"

4.4.2.3. Wireless Access Point (WAP) "100+WD-A1" (and "100+WD-A2" if applicable)

4.4.2.4. Elevator Phone "100+EL-A1" and "100+EL-A2"

4.4.2.5. Interior Emergency Phone "100+EM-A1" and "100+EM-A2"

4.4.2.6. Outdoor Emergency/Blue Light "OUTx+EM-A1" and "OUTx+EM-A2" where
"x" is "N", "E", "S", or "W" for direction from serving building or in
extreme cases, "NE", "NW", "SE", or "SW"

4.5. ALL LABELING SHALL BE COORDINATED WITH AND APPROVED BY AN APPROPRIATE UITS REPRESENTATIVE.

4.5.1. Schedule a meeting with the UITS representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.

4.5.2. In cases where the telecommunications (sub)contractor installs Wireless Access Point equipment, the equipment installer must provide a cut sheet of installed access equipment IDs and its associated data jack ID. An example of this cut sheet follows:

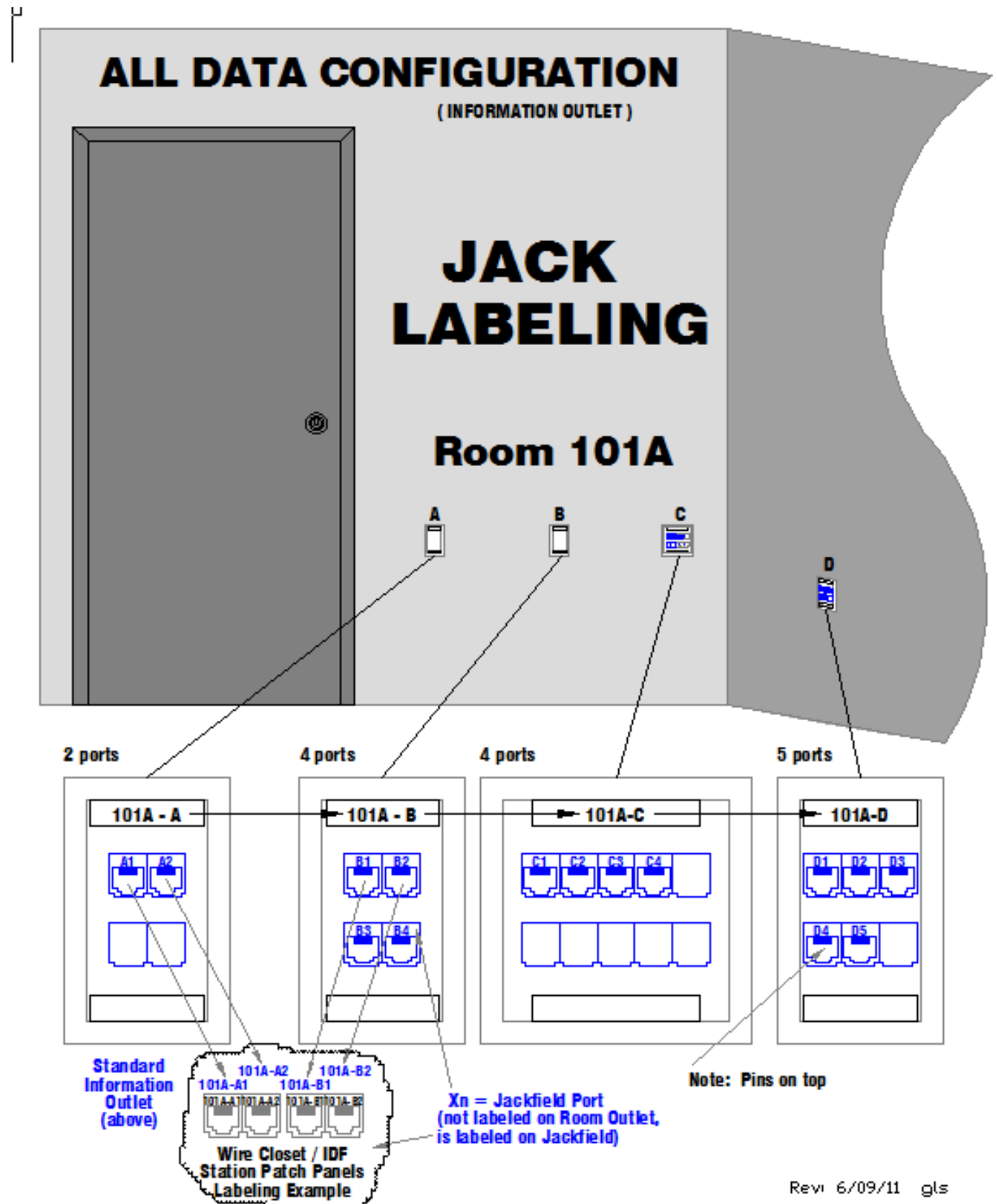
WIRELESS ACCESS PONT CUT SHEET example

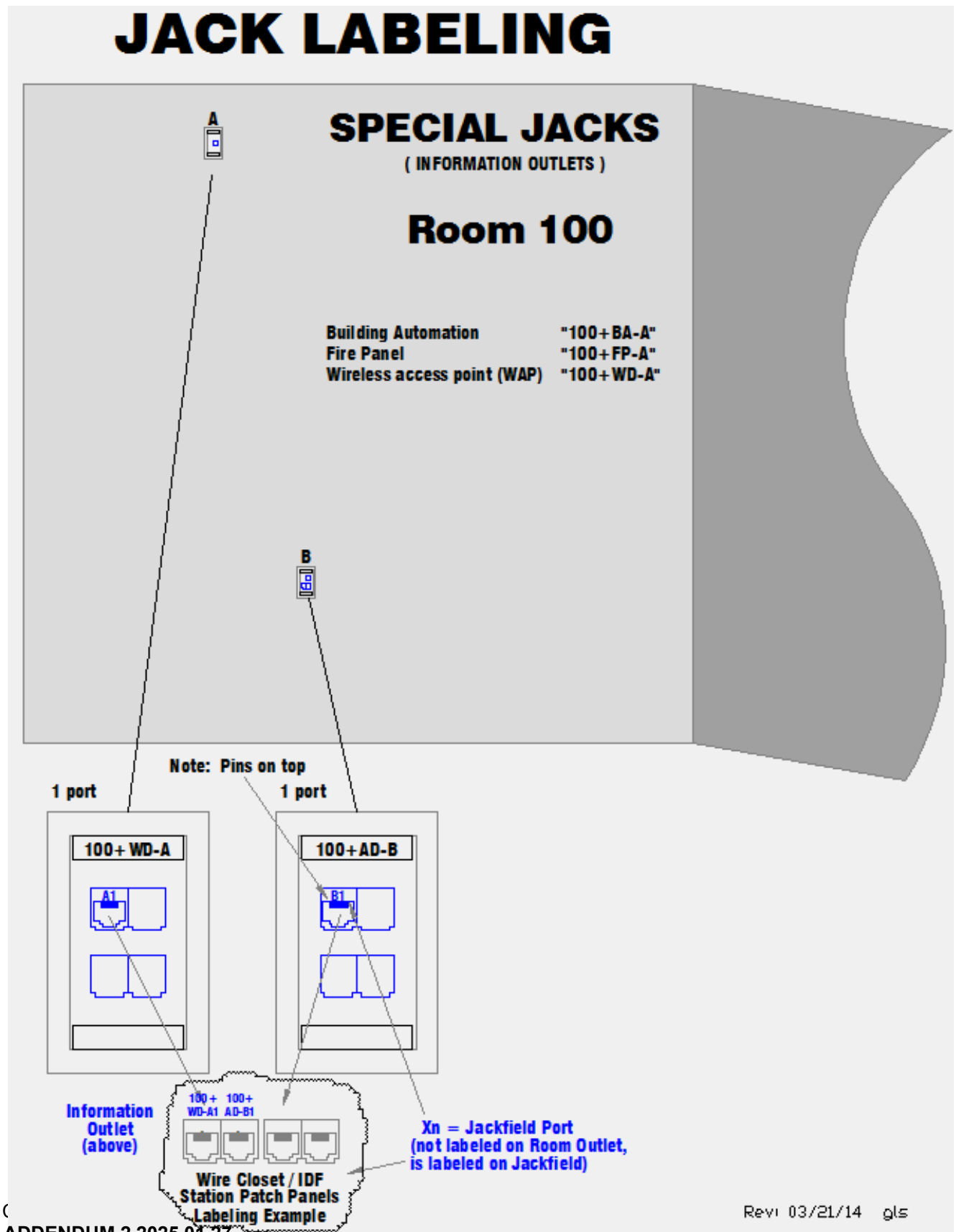
- ☐ Place the AP sticker on a sheet
- ☐ Write the Jack ID next to the sticker

Marching 100	
<PLACE AP STICKER HERE>	<WRITE JACK ID HERE>

Once complete, deliver cut sheet to UITS Wireless engineering.

LABELING EXAMPLES





27.20.00 DATA COMMUNICATIONS

User End Equipment and IDF Network Equipment provided by IU

27.30.00 VOICE COMMUNICATIONS

User End Equipment provided by IU

27.40.00 AUDIO-VIDEO COMMUNICATIONS

27.41.16 INTEGRATED AUDIO-VISUAL SYSTEMS AND EQUIPMENT

See following addenda

(otherwise User End Equipment and A/V Closet Equipment provided by IU)

27.50.00 DISTRIBUTED COMMUNICATIONS and MONITORING SYSTEMS

TBD

27.60.00 WIRELESS TRANSCEIVERS

Equipment provided by IU

----- INSERT PAGE BREAK -----

27.99.99 APPENDIX: Design Guide

----- INSERT IU Building Telecommunications Design Guidelines -----

SECTION 22 10 05 PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, above grade.
- B. Chemical-resistant sanitary waste piping.
- C. Domestic water piping, above grade.
- D. Natural gas piping, above grade.
- E. Vacuum piping, above grade.
- F. Pipe flanges, unions, and couplings.
- G. Pipe hangers and supports.
- H. Pipe sleeve-seal systems.
- I. Ball valves.
- J. Balancing valves.
- K. Flow-balancing valves.
- L. Pressure reducing valves.
- M. Strainers.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.
- D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- E. Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.
- F. Sustainable Design Documentation: For products meeting regulatory lead-content restrictions.
- G. Project Record Documents: Record actual locations of valves.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Valve Repacking Kits: One for each type and size of valve.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

1.04 DELIVERY, STORAGE, AND HANDLING

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

- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY WASTE PIPING, ABOVE GRADE

- A. Continuous Flexible Self-Plunging Waste Pipes: IAPMO IGC 361, provide to connect lavatories and sink tail piece to PVC sanitary waste piping.
- B. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- C. PVC Pipe: ASTM D2729.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 CHEMICAL-RESISTANT SANITARY WASTE PIPING

- A. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
 - 1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.

2.04 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
- ~~B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.~~
 - ~~1. PPI TR-4 Pressure Design Basis:~~
 - ~~a. 160 psig at maximum 73 degrees F.~~
 - ~~b. 100 psig at maximum 180 degrees F.~~

ADD TWO

2.05 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.
- B. Flexible Gas Piping:
 - 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 - 2. Comply with ASTM E84.
 - 3. Fittings: Provided by piping system manufacturer.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) or L (B) annealed.
 - 1. Fittings: ASME B16.26, cast bronze.

2. Joints: Flared.

D. Copper Tube: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.

2.06 VACUUM PIPING, ABOVE GRADE

A. Aluminum Tube: ASME B31.3, 6063 alloy, T5 temper.

1. Manufacturers:
 - a. Applied System Technologies; _____: appliedsystemtech.com/#sle.
 - b. Prevost Corporation; PPS: www.prevostusa.com/#sle.
2. Fittings and Joints 2-1/2 inch and Smaller:
 - a. Fittings: Comply with ASME B31.1 and ASME B31.3, aluminum or iron.
 - b. Joints: Mechanical compression, coupling, push-connect bite ring coupling with stainless steel clamping washer, or threading.
 - c. Gasket Material: High nitrile rubber seal suitable for operating temperature range from minus 4 to 176 degrees F.

2.07 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

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

2.08 PIPE SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. BMW Company; _____: www.bmwcompany.com/#sle.
2. GPT, a company of Enpro Industries, Inc; _____: www.gptindustries.com/#sle.

B. Modular Mechanical Seals:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance to service requirements.
4. Glass reinforced plastic pressure end plates.

2.09 BALL VALVES

A. Manufacturers:

1. Anvil International; _____: www.anvilintl.com/#sle.
2. Apollo Valves; _____: www.apollovalves.com/#sle.
3. Nibco, Inc; _____: www.nibco.com/#sle.

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

2.10 BALANCING VALVES

A. Manufacturers:

1. Anvil International; _____: www.anvilintl.com/#sle.
2. ITT Bell & Gossett; _____: www.bellgossett.com/#sle.
3. Taco, Inc; _____: www.taco-hvac.com/#sle.

- B. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch:
 - 1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi, minus 4 to 250 deg F WOG service.
- D. Automatic Flow Limiting Cartridge, Size 3/4 inch:
 - 1. Class 125, brass or bronze body, stainless steel cartridge, threaded connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi, 0.5 gpm WOG service.
- E. Automatic Flow Limiting Cartridge with Ball Valve, Size 1/2 to 1 inch:
 - 1. Class 125, brass or bronze body, stainless steel cartridge, leak-proof stem, threaded or soldered connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi, 0.25 to 1.5 gpm WOG service.
- F. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.11 FLOW-BALANCING VALVES

- A. Manufacturers:
 - 1. Anvil International; _____: www.anvilintl.com/#sle.
 - 2. Griswold Controls; _____: www.griswoldcontrols.com/#sle.
 - 3. Taco, Inc; _____: www.taco-hvac.com/#sle.
- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.12 STRAINERS

- A. Manufacturers:
 - 1. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
 - 2. Green Country Filter Manufacturing; _____: www.greencountryfilter.com/#sle.
 - 3. WEAMCO; _____: www.weamco.com/#sle.
- B. Size 2 inch and Smaller:
 - 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- H. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- I. Pipe Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a watertight seal.
 - 6. Install in accordance with manufacturer's recommendations.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 - 1. Perform hydrostatic testing for leakage prior to system disinfection.
 - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 - 3. General:
 - a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
- C. Gas Distribution Systems:

1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
2. General Systems:
 - a. Inject a minimum of 10 psi of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
 - b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.

D. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Section 33 01 10.58.
- B. Prior to starting work, verify system is complete, flushed, and clean.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

3.08 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

END OF SECTION

SECTION 22 66 54 – SPECIAL WASTE AND SPECIAL VENT PIPING (ABOVE GRADE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes piping and specialties for the following systems:
 - 1. Special-waste and vent, gravity-flow, non-pressure piping system designated "special waste."

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-Pressure Piping Pressure Rating: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For special-waste piping materials, components, and specialties.
- B. Coordination Drawings: For piping and specialties, including relation to other services that serve same work areas.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain pipe, fittings, and joining materials for each piping system through one source from a single manufacturer.
 - 1. Above-grade and below-grade piping material shall be obtained from the same source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of special-waste specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Charlotte Pipe.
 - 2. G.F. Products.
 - 3. IPEX - Enfield Industrial Corp.
 - 4. Orion.

2.2 PIPES, TUBES, AND FITTINGS

- A. Polypropylene Drainage Pipe and Fittings (above ground): ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 DWV dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101.

B. JOINING MATERIALS

1. Electrofusion joint fittings for all joints except for the mechanical joint fitting at the lab sink p traps.
2. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.
3. Couplings: Assemblies with combination of clamps, gaskets, sleeves or threaded parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
4. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets or threaded parts; compatible with piping and system liquid; and made by the manufacturer for joining different piping materials.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.
- B. Piping and mechanical joints shall be installed in accordance with the Manufacturer's recommendations.
- C. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
- D. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- E. The below-grade material shall be transitioned to the above-grade material in accordance with the pipe Manufacturer's recommendations.

3.2 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction. If specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Plastic-Piping mechanical-joints: Make polyolefin drainage-piping joints according to ASTM D 4101.
- C. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for support, anchors and restraint devices.
- B. Install the following:
 - 1. Vertical piping: MSS Type 8 or MSS Type 42, riser clamps.
 - 2. Individual, straight and horizontal piping runs:
 - a. 100 feet and less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 feet, if indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, straight and horizontal piping runs 100 feet or longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of vertical piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- E. Support vertical piping and tubing at base and at each floor.
- F. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- G. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2: 33 inches with 3/8-inch rod.
 - 2. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
 - 5. NPS 8: 48 inches with 7/8-inch rod.
- H. Install supports for vertical PP piping every 72 inches.

- I. All vertical pipe system drops to fixtures and equipment shall be securely anchored and supported at the top, bottom and mid-span of the wall cavity. Pipe support brackets and pipe positioning system shall be anchored to the wall cavity studs on both sides.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect special-waste piping to sinks, specialties, accessories, and equipment. Use chemical-resistant coupling, adapter, or fitting as required for materials being joined.

3.5 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

- A. Special-Waste Piping Inspection:
 - 1. Do not enclose, cover, or put drainage and vent piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in inspection: Arrange for inspection of piping system before concealing after system roughing-in and before setting fixtures and equipment.
 - b. Final inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Re-inspections: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Special-Waste Piping Testing: Test systems according to procedures of authorities having jurisdiction or, in absence of published procedure, according to the following:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in plumbing test procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. The 10-foot head of water shall stand for a minimum of 1 hour without a drop in water level. Inspect joints for leaks. Any visible leakage or measured pressure drop is a cause for test failure. Additional tests will be required after corrective measures have been taken until satisfactory results are obtained.
4. Finished plumbing test procedures: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.
7. Prepare a signed and dated affidavit of testing to be provided to the Owner's Representative within 72 hours of completion of testing. Each affidavit should contain, as a minimum the date of the test, system or subsystem tested, test medium and pressure, duration of the test, test results, name and signature of the individual performing test, name and signature of the witness to the test and whether the portion of pipe tested meets state and local regulations and Purdue requirements for leak testing. Copies of the affidavits are to be included in the operation and maintenance

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Clean piping by flushing with potable water.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train the installing Contractor's personnel to properly install mechanical-joints in accordance with the Manufacturer's recommendations.

END OF SECTION 22 66 53

SECTION 22 67 13 – PURE WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pure water piping from locations indicated to fixtures and equipment inside the building.
- B. Related Sections include the following:
 - 1. Division 11 Section “Laboratory Equipment” for laboratory wall-mounted “point-of-use” purified water equipment. Reference Laboratory Furnishing drawings for additional information.
- C. The term “Pure Water” includes high-purity water generated by reverse osmosis, deionization or distillation. Pure Water piping is also labeled “DI” on the drawings.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing pure water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Pure water distribution piping: 125 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Piping diagram with all components, valves and accessories identified.

1.5 CLOSEOUT SUBMITTALS

- A. Operational and Maintenance Data: For pure water piping and specialties to include in emergency, operation and maintenance manuals.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PURE WATER PIPE, FITTINGS, VALVES, GAUGES & SYSTEM COMPONENTS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Pipe and fittings:
 - a. Asahi / America.
 - b. G.F. Piping Systems (Georg Fischer).
 - c. IPEX / Enpure.
 - d. Watts / Orion.
 - 2. Valves:
 - a. Asahi / America.
 - b. G.F. Piping Systems (Georg Fischer).
 - c. Plast-O-Matic.
 - 3. Pressure gauges and gauge guards:
 - a. Asahi / America.
 - b. Marquest Scientific.
 - c. Plast-O-Matic.
 - 4. In-line Flowmeters:
 - a. EM-Technik.
 - b. G.F. Piping Systems (Georg Fischer).
 - c. King Instrument Co.

2.2 POLYPROPYLENE PIPING SYSTEM

A. Pipe and Fittings:

1. Polypropylene (standard) pipe and fittings shall be SDR (metric) dimensions, group 1, class 2 beta polypropylene homopolymer material. Pipe and fittings 2" and smaller shall include a pressure rating of 150 psig when measured at 68°F, 2-1/2" to 4" shall include a pressure rating of 90 psig when measured at 68°F. Fittings shall be compatible with the pipe and joint construction specified; G.F. Piping Systems ProGef Standard (PP).
2. All pipes shall be marked with the manufacturer's name, pipe size wall thickness, type, quality control mark and pressure rating. All components shall be capped and individually bagged.
3. Pipe, fittings, valves and components shall be capable of transporting 18 meg-ohm/cm resistivity water with no loss of purity. Pipe shall conform to ASTM Standards D4101, D638, D2837, D2122, FDA regulation 21-CFR-177.1520 and USP 25 Class VI.
4. Pipe and fittings shall be provided by the same manufacturer.

B. Joint Construction:

1. Standard Contact Fusion (Socket-Fused).

C. Valves:

1. Ball Valves: Polypropylene body double true-union type, full-port design, EPDM Seals, 304 Stainless Steel and glass-filled PP handle. Tested at 150 psi at 68°F. Fusion spigot compatible with joint construction type; G.F. Piping Systems Type 546-ProGef Standard-PP.
2. Check Valves: Polypropylene body, natural, virgin resin, double true-union type, cone check with guide rod and PP cone assembly or ball check assembly, blow-out proof stem, PTFE seat and EPDM Seals. Tested at 150 psi at 68°F. Fusion spigot compatible with joint construction type; G.F. Piping Systems Type 562-ProGef Standard PP.

D. Pressure Gauges:

1. Pressure Gauge Guards & Pressure Gauge: Polypropylene housing with diaphragm seal to provide protective barrier between process fluid and pressure gauge, hermetically sealed uni-body construction designed to prevent rupture of the diaphragm with removal of the gauge, Viton Seal Material, fusion spigot compatible with joint construction, integral 2-1/2" diameter, 0-160 stainless steel pressure gauge; Plast-O-Matic GGMU-V-160-PP.

PART 3 - EXECUTION

3.1 JOINT CONSTRUCTION

- A. The joint construction type shall be made in strict accordance with the pipe and fitting manufacturer's written instructions and procedures.
 1. Polypropylene Pipe and Fittings with Standard Contact (Socket-Fused) Fusion Joints:
 - a. Socket-fused joints created by the pipe & fitting manufacturer's hand or bench fusion machine conforming to ASTM D2837.
 - b. Socket-fusion machines as required to properly fuse the various pipe sizes to be joined shall be purchased, or rented, by the Contractor.
- B. The pure water pipe and fitting manufacturer shall conduct on-site training of the Contractor's installation personnel in all aspects of the product installation including storage, setup, support spacing fusion process, machine care and testing procedures. On-site training shall also include joint installation testing by the Contractor as supervised and certified by the Manufacturer.
- C. Pipe and fittings used for this piping system shall be components of the same pipe joining system and materials. Mixing of various pipe and fitting manufacturers, joint construction types and materials shall not be permitted.
- D. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- E. Label each joint with printed label identifying welder number, date/time of weld.
- F. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.
- G. Flanged fittings installed in accordance with the pipe Manufacturer's recommendations shall be permissible at pure water equipment connections.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of pure water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and in equipment rooms and service areas in right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for removal of ceiling panel and coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Install piping to permit valve servicing.
- G. Install nipples, unions, special fittings and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.
- H. Install fittings for changes in direction and branch connections. Piping shall be flushed free of all foreign material prior to usage.
- I. All joints and cutting procedures shall comply with manufacturer's written instructions and recommendations.
- J. All burrs, chips, filings, etc. shall be removed from the inside of the pipe before joining and installation.
- K. Install piping on continuous channel support free of sags and bends.
- L. Where pipe and fittings are installed in a return air plenum, install plenum pipe wrap materials as specified in Division 22 Section "Plumbing Insulation".

3.3 VALVE INSTALLATION

- A. Valves shall be specifically designed for use in a pure water system and compatible with the pure water pipe, fittings and joint construction specified.
- B. Install sectional valves close to mains on each branch and riser serving equipment.

- C. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
- F. Install plastic valves of the same material as the plastic pipe in which they are installed.
- G. Install valves in horizontal piping with stem at or above center of pipe.
- H. Install valves in position to allow full movement of stem and lever handle.
- I. Install check valves in horizontal position.
- J. Install swing check valves in horizontal position with the hinge pin level.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Vertical piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, straight and horizontal piping runs: According to the following:
 - a. 100 feet and less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 feet: MSS Type 43, adjustable roller hangers.
 - c. Support horizontal piping on continuous C channel.
 - 3. Multiple, straight and horizontal piping runs 100 feet or longer: MSS Type 44, pipe rolls.
 - a. Support pipe rolls on trapeze.
 - b. Support horizontal piping on continuous C channel.
 - 4. Base of vertical piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for plastic piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS ½ and smaller: 36 inches with 3/8 inch rod.
2. NPS ¾ and smaller: 48 inches with 3/8 inch rod.
3. NPS 1 and smaller: 54 inches with 3/8 inch rod.
4. NPS 1-1/2 and smaller: 60 inches with 3/8 inch rod.
5. NPS 2 and smaller: 66 inches with 3/8 inch rod.

F. Install supports for vertical polypropylene piping every 10 feet.

G. Install horizontal piping in continuous channel.

H. All vertical pipe system drops to fixtures and equipment shall be securely anchored and supported at the top, bottom and mid-span of the wall cavity. Pipe support brackets shall be anchored to the wall cavity studs on both sides.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

3.6 IDENTIFICATION

A. Comply with requirements for identification in Division 22, Section "Identification for Plumbing Piping and Equipment".

3.7 TESTING

A. Test pure water system piping as follows:

1. Fill pure water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced pure water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials or a maximum of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

7. The Contractor shall be responsible to provide complete testing of the system in accordance with the manufacturer's recommendations and the project manual. The Contractor shall provide record of testing data with the Operations & Maintenance Manual.
8. The Contractor shall be responsible to provide and submit water quality tests upon initial startup and subsequent 90-day performance testing. Water quality testing shall include conductivity / resistivity, bacteria levels, total dissolved solids, total solids & organics. Tests shall be documented by an independent Lab.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to test, inspect and adjust components and equipment installation and to perform startup service.
- B. Pure Water System Disinfection:
 1. On system startup, provide disinfection of the entire pure water system.
 - a. The Contractor shall be responsible to provide disinfection of pure water equipment and the piping distribution system.
 - b. The Contractor shall coordinate all disinfection procedures with the pure water equipment manufacturer, system supplier and piping system manufacturer.
 - c. Disinfection of the pure water piping system shall be required. Disinfection shall utilize a 10% concentration of hydrogen peroxide circulated for twelve (12) hours or a "Minncare" (By Minntech) solution utilizing 1% concentration for one (1) to two (2) hours.
- C. Startup, Initial Operation and Operator Instruction:
 1. On completion of the installation of the entire pure water system, conduct, check and test of all components in the system. During this period, instruct the Owner's personnel in the operation and maintenance of the system. When this work is finished, startup the system and operate it for as long as necessary to complete five consecutive days of operation at the specified performance levels. During this period, continue to instruct the Owner's personnel.
 2. During a 90-day period following the satisfactory completion of the initial five-day performance requirement, but at least 90 days from that time, select any consecutive five-day period to repeat the performance test and document the water quality.

END OF SECTION 22 67 13

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA

PHONE: 317 293-8880
FAX: 866 814-3089

01/24/25

FOR INFORMATION CONTACT
ERIC HUGHES

ENGINEERING DATA FOR
IU Research Labs Renovation

IU PROJECT #20240397,

44OP-388762

ARCHITECT

BSA LifeStructures
ENGINEER

CONTRACTOR

DWG	DESCRIPTION
	GENERAL
	Cover Sheet
TOCA	Table of Contents
	SCHEDULES
	Valve Schedule
	FHEV Schedule
	GENERAL
GEN	General Notes
LEG	Legend & Abbreviations
AWIR	ALN Wiring Specifications
FWIRE	FLN Wiring Specification
DWIR1	DXR Wiring Specification
DWIR2	DXR Wiring Specification2
TTRM	TEC Termination Specification
TTRM1	TX-I/O Termination Spec.
TTRM2	TX-I/O Termination Spec. 2
TTRM3	TX-I/O Termination Spec. 3
QSST	Q-Series Sensors Term. Spec.

DWG	DESCRIPTION
	CONTROL DRAWINGS
001-004	Swain Hall Riser
005-008	Swain AHU-S21 Control
009-012	Swain Optical Enclosure Control
013-015	Swain Exhaust Fan 8
016-018	Swain LCM-OVAS Slow Act
019-020	Swain CAV w/ HW Reheat
021-022	Swain CAV Exhaust Valve (2030)
023-026	Chemistry Riser
027-028	Chemistry LRC - LTB Fast Act
029-031	Chemistry LRC - LTB/LGEV Fast Act
032-034	Chemistry LRC - TB/EV Slow Act
035-036	Chemistry FHC Single Vertical
037-038	Chemistry VAV w/ HW Reheat
039-040	Chemistry FTR
041-043	Simon Hall Riser
044-045	Simon VAV w/ HW Reheat
	DDC PANEL LAYOUTS
046-047	SWAIN EXISTING PXCC-9
048-052	SWAIN NEW PXCM-10
053-054	PXCM-3 1ST FLR FLN SOUTH
055-056	PXCM-4 1-2 FLR FLN NORTH

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
PHONE: 317 293-8880
FAX: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH			01/20/25

Table of Contents

440P-388762

TOCA

Indianapolis																		Valve Submittal - Water																																			
Smart Infrastructure																																																					
LOCATION:																		PROJECT NAME: IU Research Labs Renovation																		DATE: 01/23/25																	
JOB NO: 44OP-388762																																				PAGE: 1																	
ENGR: WLH																																				REV:																	
GENERAL NOTES:																		UNITS:																																			
1. All valves 2-1/2" and larger have flanged ends, 2" and smaller have screwed ends.																		Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.																																			
2. All control valves and wells shall be installed by the mechanical contractor.																																																					
3. Standard abbreviations used on control valves are:																																																					
BODY TYPES: 3W - Three way; 2W - Two way; A - Angle; N.C. - Normally Closed; N.O. - Normally Open;																		ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return																																			
NOC - Ball Valve can be N.O. or N.C.; BF - Butterfly Valve; DS - Double Seated;																		CR - Capacitor Driven Return; DA - Double Acting																																			
Valve ID/ Location	Qty	Product Number				Valve Size	Body Type	Body Style	Actual Cv	Actuator Type	Design P. Drop (psi)	Required Flow (gpm)	Min (gpm)	Max (gpm)	Preset (gpm)	Steam Inlet	Press Drop (psi)	Valve Spec Sheet	Shut Off	ANSI Class	Comment																																
Mechanical System: CH FTR																						Chemistry FTR																															
V-1	5	259-02038				0.50	2W	Globe	2.50	NO-NSR	5.00	4.00	N/A	N/A	N/A	--	2.56	154 010	65	250	A140 FTR																																
Mechanical System: CH LCM-1																						Chemistry LRC - LTB Fast Act																															
V-1	1	259-02034				0.50	2W	Globe	1.00	NO-NSR	5.00	2.10	N/A	N/A	N/A	--	4.41	154 010	120	250	LTB-104																																
V-2	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-1																																
V-3	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-2																																
V-4	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-3																																
V-5	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-4																																
V-6	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-5																																
V-7	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-7																																
V-8	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-8																																
V-9	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-9																																
V-10	1	259-02032				0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-10																																
V-11	1	ALT #4	259-02034		0.50	2W	Globe	1.00	NO-NSR	5.00	1.50	N/A	N/A	N/A	--	2.25	154 010	120	250	LTB-A252-2																																	
NOTES: All control valves and wells shall be installed by the heating contractor.																																																					

**Indianapolis
Smart Infrastructure**

Valve Submittal - Water

LOCATION:		PROJECT NAME:	IU Research Labs Renovation	DATE:	01/23/25
JOB NO:	44OP-388762			PAGE:	2
ENGR:	WLH			REV:	

GENERAL NOTES:	UNITS:
1. All valves 2-1/2" and larger have flanged ends, 2" and smaller have screwed ends.	Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.
2. All control valves and wells shall be installed by the mechanical contractor.	
3. Standard abbreviations used on control valves are:	
BODY TYPES: 3W - Three way; 2W - Two way; A - Angle; N.C. - Normally Closed; N.O. - Normally Open;	ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return
NOC - Ball Valve can be N.O. or N.C.; BF - Butterfly Valve; DS - Double Seated;	CR - Capacitor Driven Return; DA - Double Acting

Valve ID/ Location	Qty	Product Number	Valve Size	Body Type	Body Style	Actual Cv	Actuator Type	Design P. Drop (psi)	Required Flow (gpm)	Min (gpm)	Max (gpm)	Preset (gpm)	Steam Inlet	Press Drop (psi)	Valve Spec Sheet	Shut Off	ANSI Class	Comment
-----------------------	-----	----------------	------------	-----------	------------	-----------	---------------	----------------------	---------------------	-----------	-----------	--------------	-------------	------------------	------------------	----------	------------	---------

Mechanical System: CH LCM-2

Chemistry LRC - LTB/LGEV Fast Act

V-1	1	259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	1.50	N/A	N/A	N/A	--	2.25	154 010	120	250	LTB-103
V-2	1	259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	1.50	N/A	N/A	N/A	--	2.25	154 010	120	250	LTB-103A
V-3	1	259-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.30	N/A	N/A	N/A	--	4.26	154 010	120	250	LTB-A140-6
V-4	1	ALT #4 259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	1.50	N/A	N/A	N/A	--	2.25	154 010	120	250	LTB-A252-1

Mechanical System: CH RPC

Chemistry LRC - TB/EV Slow Act

V-1	1	259-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.10	N/A	N/A	N/A	--	3.05	154 010	120	250	TB-102-1
V-2	1	259-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.10	N/A	N/A	N/A	--	3.05	154 010	120	250	TB-102-2
V-3	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-102A
V-4	1	259-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.00	N/A	N/A	N/A	--	2.52	154 010	120	250	TB-103B
V-5	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-103C
V-6	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-103D
V-7	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A122
V-8	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A132

NOTES: All control valves and wells shall be installed by the heating contractor.

**Indianapolis
Smart Infrastructure**

Valve Submittal - Water

LOCATION:		PROJECT NAME:	IU Research Labs Renovation	DATE:	01/23/25
JOB NO:	44OP-388762			PAGE:	3
ENGR:	WLH			REV:	

GENERAL NOTES:	UNITS:
1. All valves 2-1/2" and larger have flanged ends, 2" and smaller have screwed ends.	Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.
2. All control valves and wells shall be installed by the mechanical contractor.	
3. Standard abbreviations used on control valves are:	
BODY TYPES: 3W - Three way; 2W - Two way; A - Angle; N.C. - Normally Closed; N.O. - Normally Open;	ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return
NOC - Ball Valve can be N.O. or N.C.; BF - Butterfly Valve; DS - Double Seated;	CR - Capacitor Driven Return; DA - Double Acting

Valve ID/ Location	Qty	Product Number	Valve Size	Body Type	Body Style	Actual Cv	Actuator Type	Design P. Drop (psi)	Required Flow (gpm)	Min (gpm)	Max (gpm)	Preset (gpm)	Steam Inlet	Press Drop (psi)	Valve Spec Sheet	Shut Off	ANSI Class	Comment
-----------------------	-----	----------------	------------	-----------	------------	-----------	---------------	----------------------	---------------------	-----------	-----------	--------------	-------------	------------------	------------------	----------	------------	---------

Mechanical System: CH RPC

Chemistry LRC - TB/EV Slow Act

V-9	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A140A
V-10	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.70	N/A	N/A	N/A	--	3.06	154 010	120	250	TB-A140B
V-11	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.70	N/A	N/A	N/A	--	3.06	154 010	120	250	TB-A140C
V-12	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A142
V-13	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A148
V-14	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A150
V-15	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A150A
V-16	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.70	N/A	N/A	N/A	--	3.06	154 010	120	250	TB-A150B
V-17	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A150C
V-18	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A151
V-19	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A151A
V-20	1	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	N/A	--	2.25	154 010	120	250	TB-A153

NOTES: All control valves and wells shall be installed by the heating contractor.

Indianapolis

Smart Infrastructure

Valve Submittal - Water

LOCATION:		PROJECT NAME:		DATE:		01/23/25	
JOB NO:		440P-388762		PAGE:		4	
ENGR:		WLH		REV:			
GENERAL NOTES:							
1. All valves 2-1/2" and larger have flanged ends, 2" and smaller have screwed ends.							
2. All control valves and wells shall be installed by the mechanical contractor.							
3. Standard abbreviations used on control valves are:							
BODY TYPES: 3W - Three way; 2W - Two way; A - Angle; N.C. - Normally Closed; N.O. - Normally Open;							
NOC - Ball Valve can be N.O. or N.C.; BF - Butterfly Valve; DS - Double Seated;							
ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return							
CR - Capacitor Driven Return; DA - Double Acting							
UNITS:							
Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.							

Valve ID/Location	Qty	Product Number	Valve Size	Body Type	Body Style	Actual Cv	Actuator Type	Design P. Drop (psi)	Required Flow (gpm)	Min (gpm)	Max (gpm)	Preset (gpm)	Steam Inlet	Press Drop (psi)	Valve Spec Sheet	Shut Off	ANSI Class	Comment
-------------------	-----	----------------	------------	-----------	------------	-----------	---------------	----------------------	---------------------	-----------	-----------	--------------	-------------	------------------	------------------	----------	------------	---------

Mechanical System: CH RPC

Chemistry LRC - TB/EV Slow Act

V-21	1	ALT #3	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	--	2.25	154 010	120	250	TB-A162
V-22	1	ALT #3	259-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.00	N/A	N/A	--	2.52	154 010	120	250	TB-A162A
V-23	1	ALT #3	259-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.00	N/A	N/A	--	2.52	154 010	120	250	TB-A162B
V-24	1	ALT #4	259-02030	0.50	2W	Globe	0.40	NO-NSR	5.00	0.60	N/A	N/A	--	2.25	154 010	120	250	TB-A251
V-25	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-103B FTR
V-26	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-103C FTR
V-27	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-103D FTR
V-28	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-A122 FTR
V-29	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-A140A FTR
V-30	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-A140B FTR
V-31	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-A140C FTR
V-32	1		259-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	--	4.00	154 010	120	250	TB-A150A FTR

NOTES: All control valves and wells shall be installed by the heating contractor.

Valve Submittal - Water

DATE: 01/23/25
PAGE: 5
REV:

Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.

ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return
CR - Capacitor Driven Return; DA - Double Acting

NOTES: All control valves and wells shall be installed by the heating contractor.

Valve Submittal - Water

DATE: 01/23/25
PAGE: 6
REV:

Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.

ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return
CR - Capacitor Driven Return; DA - Double Acting

NOTES: All control valves and wells shall be installed by the heating contractor.

Indianapolis

Valve Submittal - Water

Smart Infrastructure

LOCATION:

PROJECT NAME:

DATE:

JOB NO:

IU Research Labs Renovation

01/23/25

ENGR:

PAGE:

WLH

7

REV:

GENERAL NOTES:

UNITS:

1. All valves 2-1/2" and larger have flanged ends, 2" and smaller have screwed ends.

Steam inlet pressure, actual pressure drop, and shut off pressure indicated in PSIG.

2. All control valves and wells shall be installed by the mechanical contractor.

3. Standard abbreviations used on control valves are:

BODY TYPES: 3W - Three way; 2W - Two way; A - Angle; N.C. - Normally Closed; N.O. - Normally Open;

ACTUATOR TYPES: SR - Spring Return; NSR - No Spring Return

NOC - Ball Valve can be N.O. or N.C.; BF - Butterfly Valve; DS - Double Seated;

CR - Capacitor Driven Return; DA - Double Acting

Valve ID/Location	Qty	Product Number		Valve Size	Body Type	Body Style	Actual Cv	Actuator Type	Design P. Drop (psi)	Required Flow (gpm)	Min (gpm)	Max (gpm)	Preset (gpm)	Steam Inlet	Press Drop (psi)	Valve Spec Sheet	Shut Off	ANSI Class	Comment
Mechanical System: SW LCM										Swain LCM-OVAS Slow Act									
V-3	1	ALT #1	261-02032	0.50	2W	Globe	0.63	NO-NSR	5.00	1.20	N/A	N/A	N/A	--	3.63	154 010	120	250	TB-8-0-9
V-4	1	ALT #1	261-02034	0.50	2W	Globe	1.00	NO-NSR	5.00	2.00	N/A	N/A	N/A	--	4.00	154 010	120	250	LAB 014 FTR

NOTES:

All control valves and wells shall be installed by the heating contractor.

VALVE	UNIT REFERENCE	UNIT	FLOOR	MARK	TYPE	DESIGN MAX FLOW	ACTUAL MAX FLOW	DESIGN MIN FLOW	ACTUAL MIN FLOW	VOLUMETRIC CONTROL APP	VALVE BODY SIZE	PRESSURE RANGE	MOUNTING OPTION	CONSTRUCTION CODE	CONTROL PACKAGE	CONTROLLER MODEL	ACTUATOR	FAILSAFE	FLOW TRANSMITTER	PART NUMBER
	LAB FUME HOOD EXHAUST BOX																			
1	FHEV	-	103-A	1ST	FHEV-103-A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
2	FHEV	-	103-B	1ST	FHEV-103-B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
3	FHEV	-	103A-A	1ST	FHEV-103A-A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
4	FHEV	-	103A-B	1ST	FHEV-103A-B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
5	FHEV	-	104-A	1ST	FHEV-104-A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
6	FHEV	-	104-B	1ST	FHEV-104-B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
7	FHEV	-	104-C	1ST	FHEV-104-C	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
8	FHEV	-	A140-1A	1ST	FHEV-A140-1A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
9	FHEV	-	A140-1B	1ST	FHEV-A140-1B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
10	FHEV	-	A140-2A	1ST	FHEV-A140-2A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
11	FHEV	-	A140-2B	1ST	FHEV-A140-2B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
12	FHEV	-	A140-3A	1ST	FHEV-A140-3A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
13	FHEV	-	A140-3B	1ST	FHEV-A140-3B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
14	FHEV	-	A140-4A	1ST	FHEV-A140-4A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
15	FHEV	-	A140-4B	1ST	FHEV-A140-4B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
16	FHEV	-	A140-5A	1ST	FHEV-A140-5A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
17	FHEV	-	A140-5B	1ST	FHEV-A140-5B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
18	FHEV	-	A140-7A	1ST	FHEV-A140-7A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
19	FHEV	-	A140-7B	1ST	FHEV-A140-7B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
20	FHEV	-	A140-8A	1ST	FHEV-A140-8A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
21	FHEV	-	A140-8B	1ST	FHEV-A140-8B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
22	FHEV	-	A140-9A	1ST	FHEV-A140-9A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
23	FHEV	-	A140-9B	1ST	FHEV-A140-9B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
24	FHEV	-	A140-10A	1ST	FHEV-A140-10A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
25	FHEV	-	A140-10B	1ST	FHEV-A140-10B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
ALT#4	FHEV	-	A252-1A	2ND	FHEV-A252-1A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
ALT#4	FHEV	-	A252-1B	2ND	FHEV-A252-1B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
ALT#4	FHEV	-	A252-2A	2ND	FHEV-A252-2A	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11
ALT#4	FHEV	-	A252-2B	2ND	FHEV-A252-2B	EXH	1250	200	90	AVV	112	L	H	HFO	EO11	DXR2.E17C-103B	GNP191.1P	NO	DXA.S04P1	AVV112LHHFOEO11

GENERAL NOTES FOR CONTROLS INSTALLATION CONTRACTOR (CIC)

1. All work shall be performed in accordance with the contract documents and all applicable codes and standards.
2. Provide and install all wiring, conduit, circuit breakers, etc., and any needed mounting hardware to install control devices/panels (brackets, extensions, stands, etc.) for a complete installation.
3. Mount, wire and pipe (control pneumatics) all devices including panels, sensors, relays, actuators, switches, sensor covers/guards, etc. for a complete installation.
4. All installation of the energy management system and components is by the CIC unless noted otherwise.
5. IU, IUI, IUK, IUE. , through Siemens Building Technologies, Inc., will provide all system controllers, relays, transformers, sensors, prefabricated auxiliary panels and switches unless otherwise noted. The CIC will provide all installation materials necessary to mount, install, and wire all controls devices.
6. All devices to be installed according to manufacturer's recommendations and the contract documents. Field verify exact locations of all devices/equipment. Coordinate with Siemens.
7. All routings for electrical installation are to be verified by the CIC.
8. C.I.C. shall be responsible for interlock wiring between VFDs and local disconnect switches, where applicable.
9. C.I.C. shall coordinate their work with Siemens, the Contractor, other Subcontractors, and the Owner.
10. All control devices and panels that require 120V power that are not powered by the division 26 contractor shall require a dedicated circuit from its own breaker. Provide circuit breakers and power wiring where required.
11. Mount panels on racks when wall space is not available. The engineer shows panel locations on HVAC drawings. Actual panel locations are to be coordinated with the contractors and owner.
12. All line voltage wiring shall be installed in conduit.
13. All wiring must be pulled in one length. Splicing is not allowed. All Control wiring shall be continuous.
14. All wiring in mechanical rooms, concealed and inaccessible places and/or where required by project plans and specifications shall be installed in conduit.
15. Any conductor carrying voltage greater than 24VAC shall not occupy the same conduit as low voltage wiring.
16. Conduits installed outdoors or encased in concrete shall be in rigid conduit.
17. Open cable shall be installed only where space is accessible and allowed by the project plans and specifications. In these cases, cable shall be rated for space they occupy. Provide plenum rated materials as required.
18. See specifications and IU PPA Control Design Standard document for conduit use & installation requirements.
19. Provide as-built record drawings of installation of the system.
20. Record drawings shall include routing and sizing of communications wiring, sensor wiring, power trunk wiring, transformer locations, field device locations, etc.
21. C.I.C. shall receive, handle, and store, as needed, all material to be installed under their contract. Subcontractor shall be responsible for verification of quantity received. The CIC will be responsible for verifying all received material. Discrepancies must be immediately documented with the shipping company prior to their leaving the delivery site and shall be reported in writing to Siemens Building Technologies, Inc. within 48 hours. The CIC is responsible for the security of all materials received and stored. The CIC will replace, at his expense, any materials missing or damaged.
22. Provide and install all tags and labels per plans and specifications for all control devices. Coordinate tag and label text, size and type with Siemens. Tag wiring at the field panel with the full point name. Tag wiring at the field device with the full point address.
23. Terminate all wiring. If necessary, CIC will make all cutover terminations under the supervision of Siemens Building Technologies at startup, unless otherwise directed by Siemens.
24. CIC is responsible for participating in the commissioning process to the extent that it involves their installation work.
25. For wire runs to devices that require 24 VAC such as electric valve actuators, electric damper actuators, sensing devices, etc., CIC shall use the following wiring arrangement:
 - a. For devices that use a three-wire arrangement per the control drawings for carrying the 24VAC power and signal to the device, install cable type 18-gauge 3 conductor (18-3C) unless otherwise noted on control wiring diagrams. Neutral is tied together at the auxiliary panel.
 - b. For devices that use a four-wire arrangement per the control drawings for carrying the 24VAC power and signal to the device, use the following cable types unless otherwise noted on control wiring diagrams.
 - i. Install cable type 14-gauge 2 conductor (14-2C) for the 24VAC powering the device.
 - ii. Install cable type 18-gauge 2 conductor (18-2C) for the signal controlling the device.
 - iii. Tie neutrals together at the device.
 - c. QPA and Q series sensors may be landed to the RTS port on the BACnet TEC controller and will have a pre-terminated wire in either 50- or 100-foot length. See individual drawing details for further information.
26. C.I.C. shall use control wire according to the following schedule. Purchase wire manufactured by one of the following three vendors or approved equal. If wire size is not specified coordinate with Siemens and plan on using 12 gauge.
27. Minimum conduit size: 3/4".
28. Control wiring concealed in walls will be in EMT conduit. Existing wall will be 3/4" flex if inaccessible.
29. Wire size for terminal equipment devices will be either 18 AWG – 2 conductor or 18 AWG – 3 conductor wire unless otherwise noted or providing power to the TEC.

Anixter

Description	Part Number	Application
ETHERNET 23AWG, CAT6	CMP-00424AVA-7-06	Ethernet Network Communication cabling (verify type/color)
24-1p (STR) SHD Cable-Plenum	H-B-TSP24LC-CMP	BLN trunks
24-1p (STR) SDH Cable-Plenum	H-F-TSP24LC-CMP	FLN trunks
24-1.5p (STR) FT-6 Cable-Plenum	H-F-1.5TSP24LC-CMP	MSTP FLN BACnet trunks
20-2c (Solid) Cable-Plenum	KNX-TSP20LC-CMP	KNX Cable for DXR
18-2c (STR) Cable-Plenum	H-TP18-CMP	Point/low voltage wiring
18-3c (STR) Cable-Plenum	H-3C18-CMP	DXR/TEC actuators, transducers
18-6c (STR) Cable-Plenum	1806C-2-2N-01	Point/low voltage wiring
14-2c (STR) Cable-Plenum	H-2C14-CL3P	24VAC power trunk/power for devices

Anixter Contact: Gina Menolascino, Siemens Industry Account Manager
888-479-3830
2301 Patriot Blvd. Glenview, IL, 60026
sbt@anixter.com

Belden

Description	Part Number	Application
ETHERNET 23AWG, CAT6	2413F D151000	Ethernet Network Communication cabling (verify type/color)
24-1p (STR) SHD Cable-Plenum	YR48881 0031000 (CMP)	BLN trunks
24-1p (STR) SDH Cable-Plenum	YR49243 2121000 (CMP)	FLN trunks
24-1.5p (STR) FT-6 Cable-Plenum	SPECIAL ORDER WIRE	MSTP FLN BACnet trunks
20-2c (Solid) Cable-Plenum	SPECIAL ORDER WIRE	KNX Cable for DXR
18-2c (STR) Cable-Plenum	YM48514 0061000	Point/low voltage wiring
18-3c (STR) Cable-Plenum	YM48447 0061000	DXR/TEC actuators, transducers
18-6c (STR) Cable-Plenum	SPECIAL ORDER WIRE	Point/low voltage wiring
14-2c (STR) Cable-Plenum	YM48515 0131000	24VAC power trunk/power for devices

Belden Contact: Communications Supply Corporation
317-266-1600
1560 Indiana Avenue, Indianapolis, IN 46202
buybelden@gocsc.com

The Cable Company

Description	Part Number	Application
ETHERNET 23AWG, CAT6	5652P66CMP1000	Ethernet Network Communication cabling (verify type/color)
24-1p (STR) SHD Cable-Plenum	5200BLN	BLN trunks
24-1p (STR) SDH Cable-Plenum	5200FLN	FLN trunks
24-1.5p (STR) FT-6 Cable-Plenum	5201P67FLN1000	MSTP FLN BACnet trunks
20-2c (Solid) Cable-Plenum	5212-P47KNX1003	KNX Cable for DXR
18-2c (STR) Cable-Plenum	5041SBT	Point/low voltage wiring
18-3c (STR) Cable-Plenum	5043SBT	DXR/TEC actuators, transducers
18-6c (STR) Cable-Plenum	5046P33CMP	Point/low voltage wiring
14-2c (STR) Cable-Plenum	5061SBT	24VAC power trunk/power for devices

TCC Contact: Caitlin/Bart
800-677-9473
498 Bonnie Lane, Elk Grove Village, IL 60007
ilsales@tccwire.com

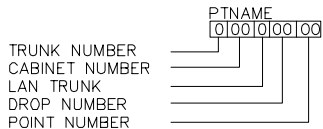
30. CIC shall create and keep an up to date list of DXR Bar Codes in a binder that is accessible to Siemens. CIC will create a list of terminal equipment that is controlled by DXR Controllers. CIC will remove the Bar Code from the DXR Controllers at the time of controls installation for each DXR and affix the Bar Code next to the associated Terminal Equipment Name in the DXR Bar Code Binder. CIC will scan the information and transmit in .pdf format to Siemens upon request.
31. CIC installation verification list. CIC shall create and keep an up to date list of the status of Mechanical System and Terminal Equipment controls installation in a binder that is accessible to Siemens. CIC will update Siemens weekly with the status of controls installation for each Mechanical System and each piece of Terminal Equipment.

CONTROL SYMBOL	CONTROL SYMBOL DESCRIPTION
AC	AIR COMPRESSOR
AD	AIR DRYER
ADXR	ACTUATOR DXR
AE	ACTUATOR ELECTRIC
AEM	APOGEE ETHERNET MICROSERVER
AF	AIR FILTER
AFS	AIR FLOW STATION
AOP	ANALOG OUTPUT, PNEUMATIC
AP	ACTUATOR PNEUMATIC
APS	AUX. POWER SUPPLY
AT	AUTOMATIC TRAP
ATD	AUTO TANK DRAIN
ATEC	ACTUATOR TEC
AZM	AUTOZERO MODULE
BCU	BUS COUPLING UNIT
BELL	BELL
BIM	BUS INTERFACE MODULE
BOIL	BOILER
BRT	BRIGHTNESS
BRTT	BRIGHTNESS AND TEMPERATURE
BTN	BUTTON
CBL	CABLES
CKV	CHECK VALVE
CM	CONSTRUCTION MATERIALS
CP	COMPONENT PANEL
CPU	CENTRAL PROCESSING UNIT
CRT	CATHODE RAY TUBE
CS	CURRENT SWITCH
CT	CURRENT TRANSDUCER
CTTE	CO2 TEMP TRANSMITTER ELEC
CVC	CONSTANT VOLUME CONTROLLER
D	DAMPER
DDC	DUAL DUCT CONTROLLER
DEM	DEMAND ENERGY MONITOR
DP	DEW POINT TRANSMITTER
DPR	DIFFERENTIAL PRESS. REGULATOR
DPS	DIFFERENTIAL PRESSURE SWITCH
DPT	DIFF. PRESS. TRANSMITTER ELEC.
DPTP	DIFFERENTIAL PRESSURE PNEUMATIC
DPU	DIGITAL POINT UNIT
DXR	TERMINAL EQUIPMENT CONTROLLER
EC	ENTHALPY COMPARITOR
EP	ELECTRO-PNEUMATIC VALVE
ES	END SWITCH
ET	ENTHALPY TRANSMITTER
EXP	EXPANSION PANEL
FAN	FAN
FHC	FUME HOOD CONTROLLER
FM	FLOW MTR. (FLOW METER STATION)
FMS	FIRE MGMT. SYSTEM
FS	FLOW SWITCH
FTP	FLOW TRANSMITTER PNEU.
G	GAUGE
GD	GAS DETECTOR
H	HYGROSTATS
HE	HUMIDIFIER ELECTRIC

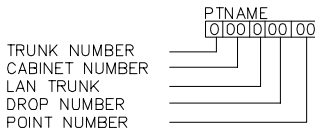
CONTROL SYMBOL	CONTROL SYMBOL DESCRIPTION
HHC	HAND-HELD OPERATOR'S TERMINAL
HL	HIGH LIMIT
HMI	GAMMA TOUCH PANEL
HOA	HAND-OFF-AUTO SWITCH
HORN	HORN
HPC	HEAT PUMP CONTROLLER
HTD	HIGH TEMPERATURE DETECTOR
HTE	HUMIDITY TRANSMITTER ELECTRIC
HTP	HUMIDITY TRANSMITTER PNEUMATIC
INT	INTERCOM
KWM	ELECTRIC KILOWATT METER
LA	LIGHT ACTUATOR
LC	LIMIT CONTROLLER (LIMITEM)
LLS	LIQUID LEVEL SWITCH
LLT	LIQUID LEVEL TRANS.
LPR	POWER SUPPLY 24VAC/24VDC
LTDE	LOW TEMP. DETECTOR ELECTRIC
LTDP	LOW TEMP. DETECTOR PNEUMATIC
LUI	LOCAL USER INTERFACE
MBC	MODULAR BUILDING CONTROLLER
MDM	MODEM
ME	ELECTRONIC ACTUATOR
MEC	MODULAR EQUIPMENT CONTROLLER
MG	MAGNEHELIC GAUGE
MPU	MULTI-POINT UNIT
MS	MOTOR STARTER
OCC	OCCUPANCY
OCCB	OCCUPANCY AND BRIGHTNESS
OBS	OBSOLETE
ODP	OPERATOR DATA PANEL
P	PUMP
PA	PULSE ACCUMULATOR
PCT	PROGRAMMABLE CLOCK TIMER
PE	PRESSURE ELECTRIC SWITCH
PL	PILOT LIGHT
PM	POWER MONITOR
PNL	PANEL
PPM	POINT PICKUP MODULE
PRC	PRESSURE REG. CONTROLLER
PRV	PRESSURE REDUCING VALVE
PS	POSITIONING SWITCH
PSE	POSITION SENSOR ELECTRIC
PST	PULL STATION
PT	PITOT TUBE
PTE	PRESSURE TRANSMITTER ELECTRIC
PTP	PRESSURE TRANSMITTER PNEUMATIC
PTR	PRINTER
PV	PILOT VALVE
PXCC	PX COMPACT CONTROLLER
PXCM	PXC-MODULAR CONTROLLER
PXG3	BACNET ROUTER ETHERNETIP-MS/TP
RBC	REMOTE BUILDING CONTROLLER
RC	RECEIVER CONTROLLER

CONTROL SYMBOL	CONTROL SYMBOL DESCRIPTION
RCU	REMOTE CONTROL UNIT
RE	RELAY ELECTRIC
RP	RELAY PNEUMATIC
RS	RESTRICTOR
RV	RELIEF VALVE
S/W	SOFTWARE
SA	SHADE ACTUATOR
SC	STEP CONTROLLER
SCU	STAND ALONE CONTROL UNIT
SD	SMOKE DETECTOR
SE	SWITCH ELECTRIC
SIO	SLX IO MODULES
SLX	APOGEE SLX CONTROLLER
SPKR	SPEAKER
SPP	STATIC PRESSURE PROBE
SPR	STATIC PRESSURE REGULATOR
SV	SOLENOID VALVE
SW	SWITCH PNEUMATIC
T	ROOM THERMOSTAT, PNEUMATIC
TBC	TERMINAL BOX CONTROLLER
TC	TEMPERATURE CONTROLLER(S200)
TCU	TERMINAL CONTROL UNIT
TDR	TIME DELAY RELAY
TE	THERMOSTAT, ELECTRIC
TEC	TERMINAL EQUIPMENT CONTROLLER
TH	THERMOMETER
TI	TRUNK INTERFACE
TIE	TRUNK ISOLATOR EXTENDER
TIU	TELCOM INTERFACE UNIT
TMR	TIMER, TIME CLOCK
TTE	TEMPERATURE TRANSMITTER ELECTRIC
TTP	TEMPERATURE TRANSMITTER PNEUMATIC
TXIO	TX-I/O FAMILY CONTROLLER MODULES
UC	UNITARY CONTROLLER
UCC	UNIT CONDITIONER CONTROLLER
UVC	UNIT VENT CONTROLLER
V	VALVE
V*	VALVE SERVICE PARTS
VA	TEC VALVE ACTUATOR
VAC	VARIABLE AIR VOLUME CONTROLLER
VB	VIBRATION ISOLATOR
VTE	VELOCITY TRANSMITTER ELECTRICAL
W	WELL
WST	WEATHER STATION
XDR	TRANSDUCER
XFMR	TRANSFORMER

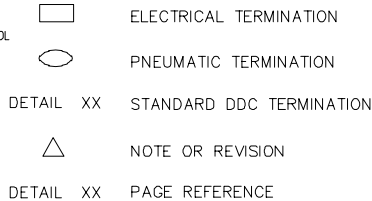
DDC ELECTRICAL POINT



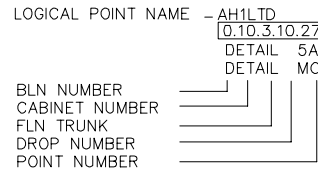
DDC PNEUMATIC POINT



DETAILS

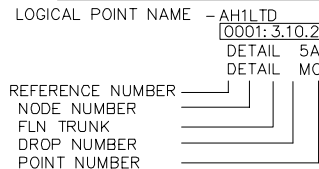


APOGEE: PII - EXAMPLE



READ AS " SEE PAGE 5A FOR MORE DETAIL "

APOGEE: ETHERNET - EXAMPLE



READ AS " SEE PAGE 5A FOR MORE DETAIL "

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
PHONE: 317 293-8880
FAX: 866 814-3089

IU Research Labs Renovation

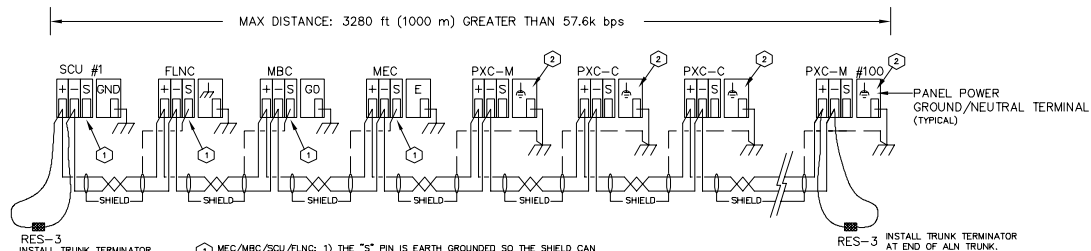
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH			01/16/25

Legend & Abbreviations

44OP-388762

LEG



RES-3
538-664
BLN TRUNK TERMINATOR

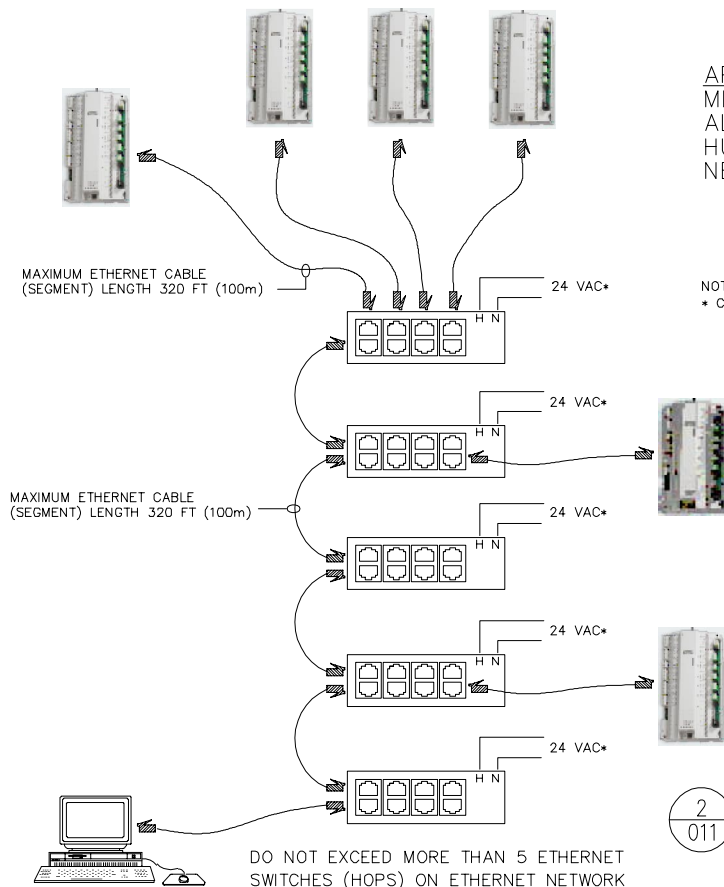
- ① MEC/MBC/SCU/FLNC: 1) THE "S" PIN IS EARTH GROUND SO THE SHIELD CAN BE CONNECTED THERE.
- ② PXC-M/PXC-C: 1) THE "S" MUST BE TIED TO EARTH GROUND.
2) THE "ST" PIN OF THE PXC-M AND PXC-C MUST BE LEFT OPEN.

1 SIEMENS P2 ALN (BLN) NETWORK

011 SIEMENS P2 AUTOMATED LEVEL NETWORK (ALN)
COMMUNICATION PROTOCOL: RS-485

APPLICABLE TO:
MLN (WORKSTATION TO ETHERNET)
ALNs (ETHERNET, BACnet/IP, AEM)
HUBS, SWITCHES, ROUTERS
NETWORK INTERFACE CARD

NOTE:—
* CERTAIN MODELS MAY REQUIRE 24 VDC OR 120 VAC..



DO NOT EXCEED MORE THAN 5 ETHERNET SWITCHES (HOPS) ON ETHERNET NETWORK

2 SIEMENS ETHERNET NETWORK

011 10Base-T/100Base-TX
COMMUNICATION PROTOCOL: ETHERNET TCP/IP

ALN ETHERNET CABLE SPECIFICATIONS	
	TWISTED PAIR TWISTED PAIR TWISTED PAIR TWISTED PAIR
4 UNSHIELDED TWISTED PAIR (UTP) 24 AWG (SOLID) 17 PICO FARAD/FT CAPACITANCE AT 1KHz, 1MHz IEEE802.3 CATEGORY 5 CERTIFIED OR BETTER	
SHIELD NONE	
PART NUMBERS	
PLEASE REFER TO CERCO AND ANIXTER CABLE PART NUMBERS (SEE DRAWINGS 6A & 6B).	

ALN TSP CABLE SPECIFICATIONS	
	TWISTED PAIR SHIELD
TWISTED PAIR 24 AWG (STRANDED) 12 PICO FARAD/FT CAPACITANCE OR LESS 4 TWISTS PER FOOT.	
SHIELD 100% OVERALL FOIL	
PART NUMBERS	
PLEASE REFER TO CERCO AND ANIXTER CABLE PART NUMBERS (SEE DRAWINGS 6A & 6B).	

NOTES:

NEVER RUN NETWORK CABLING CLOSER THAN 5 FEET TO A VARIABLE FREQUENCY DRIVE (VFD) EXCEPT AT THE POINT WHERE THE NETWORK MUST CONNECT TO THE VFD. NETWORK ENTRY INTO A VFD MUST BE THROUGH A SEPERATE CONDUIT AND ALL NETWORK WIRING MUST BE KEPT AS FAR AS POSSIBLE FROM HIGH POWER CABLING IN THE DRIVE.

NEVER RUN NETWORK CABLE CLOSER THAN 5 FEET FROM CONDUITS CARRYING 100KVA OR GREATER. ALWAYS CROSS HIGH POWER CABLES (AT A DISTANCE OF 5 FEET) AT A 90° ANGLE.

NETWORK CABLE RUN IN OPEN CABLE TRAYS WITH CIRCUITS CARRYING 20 AMPS SHOULD BE NO CLOSER THAN 26 INCHES TO THE HIGHER POWER CABLES.

NETWORK RUN IN ENCLOSED TRAYS WITH CONDUITS CARRYING OVER 20 AMPS SHOULD BE NO CLOSER THAN 18 INCHES TO THE HIGHER POWER CABLES.

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

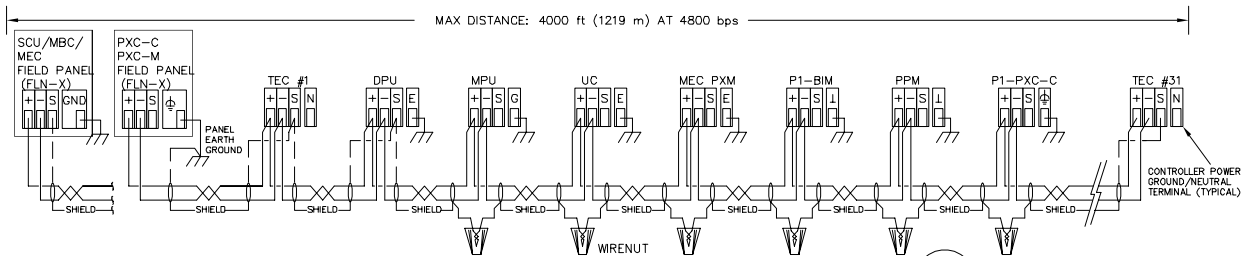
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	RM	01/17/25	01/20/25

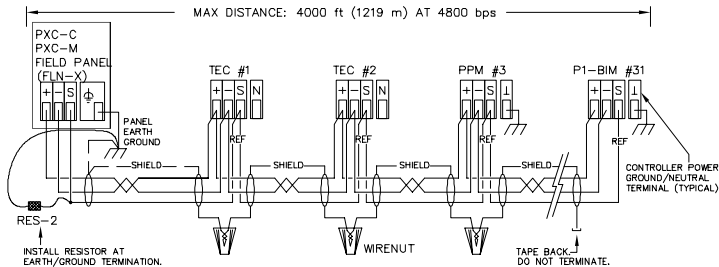
ALN Wiring Specifications

440P-388762

AWIR

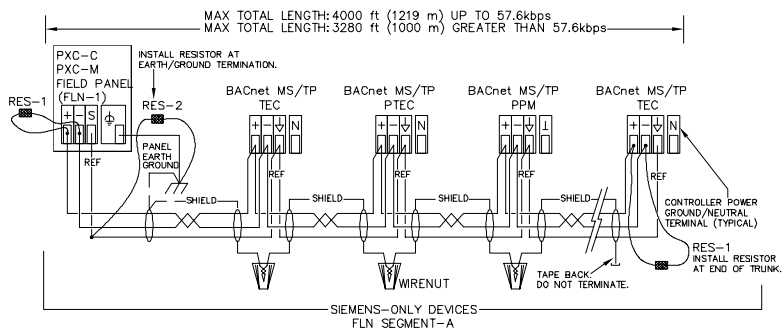


1 SIEMENS LEGACY P1 FLN NETWORK
SIEMENS P1 FLOOR LEVEL NETWORK (FLN)
COMMUNICATION PROTOCOL: RS-485
WIRING FOR 1 PAIR (2 CONDUCTOR TSP)



RES-2
550-974P10
EARTH TERMINATOR RESISTOR

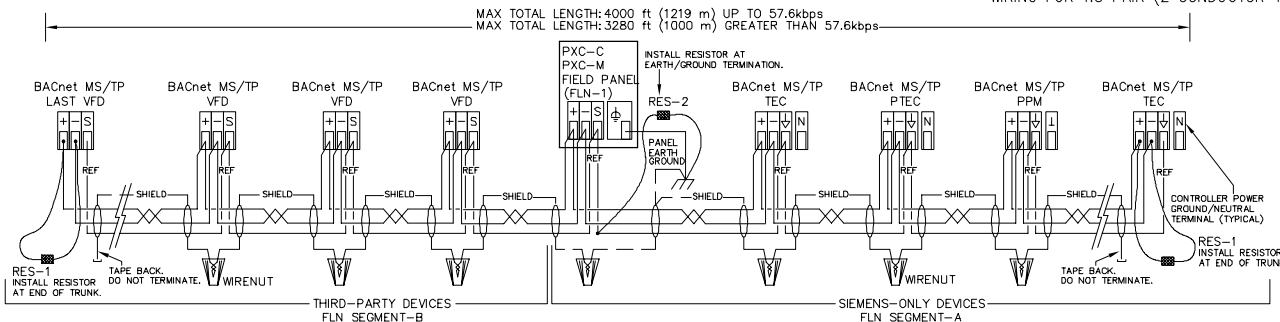
2 SIEMENS P1 FLN NETWORK
SIEMENS P1 FLOOR LEVEL NETWORK (FLN)
COMMUNICATION PROTOCOL: RS-485
WIRING FOR 1.5 PAIR (2 CONDUCTOR TSP, & 1 CONDUCTOR)



- NOTES:
- 1) FLN WIRING MUST BE CONNECTED IN A DAISY-CHAIN.
 - 2) FOR SIEMENS-ONLY FLN NETWORK, WIRE AS SHOWN FOR FLN SEGMENT-A. INSTALL END-OF-LINE RESISTOR RES-1 AT FIELD PANEL AND ON LAST TEC.
 - 3) FOR FLN NETWORK WITH SIEMENS & THIRD-PARTY DEVICES, WIRE AS SHOWN WITH FLN SEGMENT-A AND SEGMENT-B. INSTALL END-OF-LINE RESISTOR RES-1 ON LAST TEC AND ON LAST THIRD-PARTY DEVICE. DO NOT INSTALL E-O-L RESISTOR ON FIELD PANEL.

RES-1
550-975P100
120 OHM 1/2W RESISTOR
RES-2
550-974P10
EARTH TERMINATOR RESISTOR

3 BACnet MS/TP FLN NETWORK
BACnet MASTER/SLAVE TOKEN PASSING NETWORK
COMMUNICATION PROTOCOL: RS-485
WIRING FOR 1.5 PAIR (2 CONDUCTOR TSP, & 1 CONDUCTOR)



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	RM	01/17/25	01/20/25

FLN Wiring Specification

FLN TSP CABLE SPECIFICATIONS



TWISTED PAIR
24 AWG (STRANDED)
12 PICOFARAD/FT CAPACITANCE OR LESS
4 TWISTS PER FOOT.

SHIELD
100% OVERALL FOIL

PART NUMBERS

ANNIXTER

PART NUMBER: H-AF-TSP24LC-CMPBX-P
DESCRIPTION: ALN/FLN24AWG,STR,TSP,LOCAP,CMP (FT-6)

FLN 1.5 PAIR CABLE SPECIFICATIONS



TWISTED PAIR
24 AWG (STRANDED)
11 PICOFARAD/FT CAPACITANCE CONDUCTOR TO CONDUCTOR.
24 PICOFARAD/FT CAPACITANCE CONDUCTOR TO SHIELD.
4 TWISTS PER FOOT.

REFERENCE WIRE

24 AWG (STRANDED), 3 INCH LAY WITH TWISTED PAIR

SHIELD
100% OVERALL FOIL WITH DRAIN WIRE

PART NUMBERS

ANNIXTER

PART NUMBER: H-A-1.5TSP24LC-CMP-Y
DESCRIPTION: 24-1.5PR STR TC FFEP FT6 SHD YEL (FT-6)

CERCO

PART NUMBER: 8304R
DESCRIPTION: 22AWG 3C STR FT6 ORG (FT-6)

NOTES:

NEVER RUN NETWORK CABLING CLOSER THAN 5 FEET TO A VARIABLE FREQUENCY DRIVE (VFD) EXCEPT AT THE POINT WHERE THE NETWORK MUST CONNECT TO THE VFD. NETWORK ENTRY INTO A VFD MUST BE THROUGH A SEPARATE CONDUIT AND ALL NETWORK WIRING MUST BE KEPT AS FAR AS POSSIBLE FROM HIGH POWER CABLING IN THE DRIVE.

NEVER RUN NETWORK CABLE CLOSER THAN 5 FEET FROM CONDUITS CARRYING 100KVA OR GREATER. ALWAYS CROSS HIGH POWER CABLES (AT A DISTANCE OF 5 FEET) AT A 90° ANGLE.

NETWORK RUN IN OPEN CABLE TRAYS WITH CIRCUITS CARRYING 20 AMPS SHOULD BE NO CLOSER THAN 26 INCHES TO THE HIGHER POWER CABLES.

NETWORK RUN IN ENCLOSED TRAYS WITH CONDUITS CARRYING OVER 20 AMPS SHOULD BE NO CLOSER THAN 18 INCHES TO THE HIGHER POWER CABLES.

440P-388762

FWIRE

Important Safety Information

System-specific:

The electrical safety for building automation and control systems by Siemens Building Technologies is essentially based on safely separating low voltage from mains voltage.

Application as per SELV or PELV pursuant to HD 384 "Electrical installation of buildings" depending on the grounding (24V AC) of the low voltage:

Ungrounded = Safety Extra-Low Voltage (SELV).

Grounded = Protection by Extra Low Voltage (PELV).

Device-related safety is guaranteed, among others, by:

1. Low-voltage power supply 24V AC per SELV or PELV
2. Comply with specific regulations for electrical wiring per the following sections.
3. Observe the following points when grounding 24V AC (system neutral):
4. Operating voltage of 24V AC is permitted in principle for both grounded as well as non-grounded system neutral. Local regulations and customers apply accordingly.
5. Grounding may be required or not allowed for functional reasons.
6. 24V AC systems are generally grounded unless disavowed by the manufacturer.
7. In order to avoid ground loops, connect systems with PELV to the ground at one location only (especially for transformers), if no other indication exists.

Mains and operating voltage:

Operating voltage 24V AC:

1. It must meet requirements for SELV or PELV. Permitted deviation for nominal voltage 24V AC on the device: -10 +/– 20%.

Transformer specification 24V AC:

1. Use safety insulating transformers as per EN 61558 with double insulation designed for 100% duty to supply SELV or PELV circuits..
2. Power taken from the transformer should be at least 50% of nominal load for efficiency reasons (effectiveness).
3. Transformer nominal power should be at least 25VA. For smaller transformers, the ratio of open circuit voltage to full load is unfavorable (> + 20%).

Operational voltage fuse 24V AC:

Transformers on the secondary side correspond to the actual load of all connected devices as per transformer sizing:

1. 24V AC line (system potential) must always be fused.
2. There required, also line (system neutral).

Mains filter:

Spikes and high-frequency interference may occur in areas with high levels of interference. The disturbances not only impact the transformer on the primary side, but may also influence secondary connected components.

A mains filter should be attached on the primary transformer if such interference is anticipated. Mains filters should be installed as close to the network transformer as possible and grounded.

Device-specific :

Devices using different power circuits:

Devices must have the required insulation of the power circuits from each other to be able to connect them directly without additional insulation.

Interfaces for different voltage circuits :

Connections via interfaces increase the risk of distributing dangerous voltage through the building. Ensure that the required insulation is available at all times and installed per applicable regulations.

DXR2 with 24V AC supply:

1. A class 2 transformer or an external T4 A fuse is compulsory.
2. Max. 100VA per transformer / per fuse circuit.

Installation:

Mounting position:

Recommended:

1. Wall, horizontal from left to right or from right to left.
2. Wall, vertical from bottom to top.
3. Ambient temperature 23 to 122°F (–5 to 50 °C)

AC 24V power lines:

1. DXR2 room automation stations with 24V AC supply are limited to a consumption of 4A/100VA.
2. Supply: Class 2 transformer OR external 4A fuse OR transformer >100VA for more than one DXR2. (In this case a separate 4A fuse is required for every 100VA).
3. DXR2 room automation stations with 24V AC supply can only be wired in star topology.
4. An external power supply of field devices should be fused separately for secure operation.

24V AC Transformer :

Operating voltage :

1. The operating voltage is 24V AC. It must comply with SELV or PELV to HD 60364–4–41 (2007–01–01) requirements.
2. The acceptable deviation of the 24V AC nominal voltage connected to the transformer is +20%/–10%. This means that after taking account of the cable and contact resistances, a tolerance of +/-20% for the field device supply can be guaranteed in the field devices.

Specification for 24V AC transformers:

1. Double-insulated safety transformers to EN 61558, designed for continuous operation, to supply SELV or PELV circuits.
2. The rated transformer output must be at least 50VA. In smaller transformers the ratio of no-load voltage to full-load voltage is unfavorable (> +20%).
3. For reasons of power efficiency the rated transformer output should not exceed 200 % of the maximum load.

Wiring DXR2:

The 24V AC can only be wired in star distribution for the DXR2 room automation stations. 24V AC must be fused with max. 4A (or Class 2 transformer).

Power consumption DXR2 24V AC:

Max. permissible input current 24V AC (through terminals 5 and 6) = Total max. 4A.

Base load (without loading by field devices)

DXR2.M11, DXR2.x12P	9VA
DXR2.M18	11VA
DXR2.E18	13VA
KNX PL–Link supply	5VA/3W
29V DC / Max. 50 mA	

The bus supply can be switched off manually via tool if not used. Transit power 24V AC

Field supply 24V AC	Max. 6VA
Field supply 24V DC (DXR2.E18 only)Max. 2.4W	
Digital output (triac active)	6VA (250mA)

Note: Certain applications ensure that only one triac at a time is active: No simultaneous heating and cooling. Two heating outputs are alternatively on 50% of the time, the same with two cooling outputs. This can be considered in the transformer sizing.

Unconfigured triac	6VA (250mA)
--------------------	-------------

Cable lengths 24V AC

The permissible voltage drop of 0.6 V on the power wire between the transformer and the most distant power point (room automation station, power module, bus interface module) is the basis for calculations.

Permissible load [VA]

Cable length for 24V AC (Si)			
Cable X–section	2.5m	5.0m	10m
AWG16	200VA	100VA	50VA
AWG14	320VA	160VA	80VA
Cable length for 24V AC (US)			
Cable X–section	8.2ft	16.4ft	32.8ft
AWG16	200VA	100VA	50VA
AWG14	320VA	160VA	80VA

Notes :

1. The supply wire (24V AC) and return lines can each have the indicated lengths.
2. Power is added together for multiple back-to-back looped PXC3 or DXR2 ("daisy chain") which reduces the cable length accordingly.
3. Each supply point (room automation stations/power module/bus interface module) is either connected separately to the transformer's terminal block (star wiring) or looped via the room automation station.
4. Cables may be wired in parallel to increase the cross section.

Wiring of field devices (without bus)

As a rule, comply with local regulations for electrical installations. These take precedence over any notes in this document.

Wiring for Triac outputs 24V AC.

The following applies for wiring to actuating devices such as valves, damper actuators or protection connected to the Triac outputs:

1. Use stranded, 2 or multiple core round cables, screened (standard off-the-shelf installation cable).
2. Single wires may not be used.
3. Wiring may be laid together with power lines (230V AC). They must be isolated from the power lines per regulations. Isolation must meet PELV requirements.
4. Wiring can not be led in the same cable as the power lines.
5. See table below for maximum single cable lengths. However, the length must not exceed 984ft (300m) (EM interference). DXR2: 262ft (80m).

DXR2 room automation stations with 24V AC supply:

Use cable cross section suited for 4A according to local regulations (T 4A fuse external / Class 2 transformer). Cable cross section >= AWG18. Triacs are not protected and are destroyed if overloaded.

2. Cable length <= 262ft (80m)

Signal wiring

The following applies in common for signal wiring of field devices such as temperature sensors, window switches, presence detectors, dew point sensors or electrical buttons:

1. Use stranded, 2 or multiple core round cables, without screen (standard off-the-shelf installation cable).
2. Single wires or ribbon cables may not be used.
3. Signal wiring may be laid together with power lines (230V AC). They must be isolated from the power lines per regulations. Isolation must meet PELV requirements.
4. Signal wiring can not be led in the same cable as the power lines.
5. The length must not exceed the following value (measuring errors, EM interference): DXR2: 262ft (80m).
6. All system neutral terminals of a device are interconnected. TX–I/O: The connection is not in the terminal base but in the plug-in module. When this unit is unplugged there is no connection.
7. The system neutral of a digital input can be connected to any signal neutral terminal of the device.
8. It is also permissible to combine the system neutral conductors of several digital inputs in order to save wire. TX–I/O: However, system ground must be connected at least once per module.
9. With analog inputs and outputs, the measuring neutral must always be connected to the terminal associated with that specific I/O point to avoid possible measurement errors.
10. 0 to 10V DC actuators with 0 to 10V DC feedback: System neutral of output and feedback may be in the same conductor due to the small current of the U10 and Y10 signals. However, output and feedback must be on the same device and there is no 24V DC supply current admissible on the system neutral conductor.

Relay outputs

1. External fuse of max. 10A for protection of the PCB tracks.
2. Relays have volt-free relay contacts. The mains voltage / switching voltage (230V AC / 24V AC/DC) must be supplied as an external voltage to the terminals.
3. The maximum load of the relay contracts must be observed (see data sheets for the corresponding devices)
4. The sizing and fusing of the power lines are oriented to overall connected load and local regulations.
5. The fused electrical values must therefore be reviewed in the data sheets for the corresponding devices.
6. The lines must be secured on the device with strain relief.
7. Cable length: as per load and local regulations.
8. The maximum current of the relays is limited to 4 (3)A.

Inputs and Outputs

Digital inputs

Cable length

The permissible length of the cables connected to the status contacts, regardless of the thickness of the wire (min. diameter 0.024in / 0.6mm) is restricted to 262ft (80m).

Common conductor with multiple contacts:

When several status or counter contacts are to be connected, a common conductor may be used. This saves wiring. However, system ground must be connected at least once per module. Digital inputs are not electrically isolated from the system electronics. Mechanical contacts must be volt-free. Electronic switches must comply with SELV or PELV standards.

Analog inputs

Cable length:

The maximum permissible cable length for passive resistance sensors and transmitters depends on the permissible measuring error due to the line resistance. The maximum cable length for DXR2 is 262ft (80m).

Active sensors 0 – 10V DC

Cable length:

The maximum cable length for DXR2 is 262ft (80m). The permissible length of 10V DC cables for measured signals, and of the cables to supply the sensors from the TRA device, have to be calculated on the following basis for each active sensor.

1. Max. 7% voltage drop (1.68V) on the cables due to the sensor supply current. Reason: to ensure sufficient voltage for the sensor supply.
2. Measuring error of max. 0.5% of the measuring range due to line resistance on the measuring conductor (not critical, as the measuring current is only 0.1mA)
3. Longer cables are permissible provided larger measuring errors are acceptable.
4. If the active sensor is supplied locally from a transformer, the sensor cable can be up to 984ft (300m) long (DXR2: 262ft (80m)) with a wire diameter of greater than or equal to 0.024in (0.6mm). The local transformer MUST NOT be earthed (earth loop)!
5. In case of active sensors with 24V AC supply, use cable cross section suited for 10A according to local regulations .
- 6.

Digital outputs (relays, triacs)

Cable length:

The cable between the switching outputs and the equipment to be switched may be up to 262ft (80m) for DXR2.

The permissible lengths of the cables between the relay outputs / triacs and the actuators depend on the type of actuator in use and are calculated as follows:

Relays: Voltage drop of max. 7% (1.68V) on the 24V AC operating voltage for the actuator.
Triacs: Voltage drop of max. 3% (0.72V) on the 24V AC operating voltage for the actuator (the triac itself has already 4% voltage drop).

Analog outputs

Cable length

The permissible cable lengths for 0 – 10V DC control signals and for the 24V AC operating voltage are given in the data sheets of the individual actuators.

Where the actuators are supplied locally with 24V AC, the control signal cable may be up to 984ft (300m) long (DXR2: 262ft (80m)) with a diameter of greater than or equal to 0.024in (0.6mm).

The local transformer MUST NOT be earthed (earth loop)!

0 – 10V DC actuators with 0 – 10V DC feedback: System neutral of output and feedback may be in the same conductor due to the small current. However, output and feedback must be on the same device.

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
PHONE: 317 293-8880
FAX: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH			01/16/25

DXR Wiring Specification

440P-388762

DWIR1

Ethernet network:

Network topologies

- Star topology (general).
- Line topology (for room automation).
- DXR2 and PXC3 can be mixed.
- The number of room automation stations is limited to 20 for a line topology (daisy chain).
- The next device has no 24V AC power when a room automation station is removed. The connection exists only on the board, but not on the terminal block.
- The Ethernet switch is inactive when a room automation station has no 24V AC power. The next devices, if in line topology, are disconnected from the network. For secure operation of the system it is recommended to supply each room automation station separately with 24V AC.

Cables – Room automation stations are connected to one another via switches and Ethernet cables with RJ45 connectors. The following conditions must be met:

- Standard Ethernet cable min. category 5
- Shielded or unshielded STP (Shielded Twisted Pair) or UTP (Unshielded Twisted Pair).
- Length between switch and Room automation station max. 328ft (100m).
- Length between Room automation stations Max. 328ft (100m).
- Number of devices under a line topology max. 20.
- Standard IT product at 100MB or 1GB.

Power over Ethernet (PoE) – Power over Ethernet (PoE) is a simple solution to supply power to room operator units consuming only little power. This saves a power cable and associated installation costs. PoE allows for installing Ethernet devices also in hard-to-access locations or areas where too many cables are an issue. In PoE, power sourcing equipment (PSE) supplies power to powered devices (PD, here: end devices). Voltage is supplied via the RJ45 plugs and a twisted-pair cable (TP) to the devices either:

- Via data transmission lines
- Or via unused lines of the RJ45 connection.

PoE requires a star topology. Standard PoE switches have between 4 and 16 outputs. In large plants (e.g. different rooms in a hotel) require use of multiple switches in a line topology.

Specifications:

Standard Ethernet cable	min category 5
Screened or unshielded	STP / UTP
STP (Shielded Twisted Pair)	
or UTP (Unshielded Twisted Pair)	
Distance between switch and station =	max 328ft (100m).
Distance between switch and end unit =	max 328ft (100m).

MS/TP networks:

Network topologies – MS/TP networks for Desigo TRA can only be wired in line topology. The network distance for a fully or partially loaded network is 4000ft (1220m) at a maximum network speed of 76,800 bps. Lower speeds do not mean longer network sections are possible. DXR2 controller support up to 115,200 bps. Network repeaters can be used to extend this distance.

To determine how many devices can be on a network section, add up all the loading numbers and do not exceed 32. Many third-party devices have full load interfaces. Check the manufacturer's literature for network loading information. The RS-485 specification allows 32 full load devices on a section of network cable before a repeater is required. Desigo TRA devices are 1/8 load devices, so, in theory, you could place 256 on a network section.

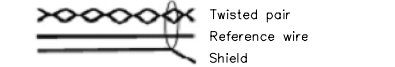
Response times normally limit the maximum number of devices on a network to lower values of around 96 devices.

- Two 1200hm 1/2W resistors between + and – at BOTH ends of the network section.
- OneSpecial PTC thermistor between Reference () and earth at ONE end of the network section. This prevents the cable from being damaged by high ground currents that may occur if the reference wire is accidentally grounded to earth ground at a second location.

Technical data BACnet MS/TP – Inter-node protocol communications on BACnet MS/TP networks take place over RS-485 physical media.

Desigo TRA devices use the 3-wire interface.

- By providing the RS-485 ground signal of the interface to the network termination plug, all node communication ports can be referenced together providing a high degree of noise immunity.
- The RS-485 common reference wire is terminated at one point (and only one point) to earth ground.
- An overall foil shield and drain wire provide additional noise protection.
- The decision to use the orange jacket cable or orange jacket with blue stripe cable is up to the user/customer. The only difference in the cables is the addition of the blue stripe, which can be useful to indicate a different protocol usage (e.g. Automatic level vs. floor level network).



Cable Specifications

Transmission medium	1.5-Pair (1 TP & 1 conductor) (bus cable)
Gauge (pair)	with overall Shield and drain wire 24 AWG (0.25 mm2) stranded
Capacitance	
conductor to conductor	12.5 pF/foot (41 pF/m)
conductor to shield	24 pF/foot (79 pF/m)
Impedance	120 Ohm
Twists	min. 4 per foot (13 per m)
Reference wire	24 AWG (0.25 mm2) stranded, 3 inch lay with twisted pair
Shield	100% overall foil with drain wire
NEC class	UL listed, CM, CMP (167°F (75°C or higher)
CEC class	FT4, FT6 (167°F (75°C) or higher)

KNX PL-Link room bus:

- The KNX PL-Link bus must be conducted inside the building. The cables must never leave the building.
- The KNX PL-Link bus facilities communications from the PXC3 room automation station to a maximum 64 devices on the KNX bus devices for various manufacturers.
- Note: The number of devices is also limited by the number of data points and the available bus power. Data points and bus power are incremented during engineering with the ABT tool.
- The KNX PL-Link bus basic version comprises one cable and two stranded bus wires.
- The PXC3 has one internal bus power supply of 160mA.
- The DXR2 has one internal bus power supply of 50mA.
- The PXC3 also includes an 24V AC / 2A output for devices with increased power consumption that is supplied via 24V AC rather than via the KNX PL-Link bus.
- The KNX PL-Link is physically based on the KNX bus (Konnex).
- In KNX networks area/line couplers and IP routers are not admitted.

- Interconnection of room automation stations via KNX PL-Link is not admissible; the connection is done exclusively via Ethernet switches (Section 9).
- The polarity of the KNX PL-Link bus conductors must be respected (KNX terminals + and –).

Bus power supply – A bus power supply is required for bus communications. Throttled voltage 29V DC is used.

Internal KNX PL-Link Power Supply:

The room automation stations have an internal bus power supply, which is switched on by default. If an external supply is used, the internal supply must be switched off manually in the ABT (KNX PL-Link rail properties), as parallel operation is not permitted. Bus power and the KNX bus are electrically isolated from device electronics for devices with bus power. Parallel operation of the internal KNX PL-Link bus supply with an external bus power supply is not permitted.

The internal bus power supply must be switched off in the tool when an external bus power supply is used.

External bus supply:

An external bus power supply unit (PSU) is required when the 160mA of the PXC3 / the 50mA of the DXR2 is insufficient to cover the power demand of the connected devices.

Power supply units for 160, 320 and 640mA available in specialty stores. The total power supply for the devices must be calculated to determine the appropriate size. Comply with the corresponding details in the datasheet.

A 640mA power supply unit suffices for a line featuring 64 devices on the KNX bus with an average power demand of 10mA each.

(Parallel operation)

- In principle, parallel operation of external bus supplies among themselves is possible. However, check if the specific PSU is allowed to be operated in parallel with other PSUs. Refer to the technical specifications. The below mentioned Siemens devices are not submitted to this restriction.
- A minimum cable distance is required between two PSU.

Bus topologies – Up to 64 devices with KNX PL-Link can be installed on one line (main line as well). No restrictions apply to the type mix.

Note:

- There is no need to calculate the bus load number E for up to 64 devices.
- A maximum of 64 devices may be installed even if devices requiring less power are used.

Permissible bus topologies are: Tree, line, and star topologies. These topologies can be mixed as needed. However, ring topologies are not allowed. The tree topology is advantageous if a large network must be created.

Cables

The bus lines (= wired pair) are connected via PL+ (red) and PL- (black).



24V AC can be provided in the same (2 x 2 stands) or in a separate cable.

Bus cable screening : In TRA plants, bus cables without screen are permitted. The screens available for bus cables do not need to be connected. If interference is expected on the KNX bus, use a cable with screen. Connect the screen as per standard installation rules.

Network with internal power supply: Comply with the following distances for a KNX network with the internal power supply from the room automation station:

- Distance between device and internal supply, max 262ft (80m).
- Distance between devices, max 262ft (80m).
- Total length of all lines on one line, max 262ft (80m).

Network with external power supply: Comply with the following distances for a KNX network with external bus power supply (PSU)

- Distance PSU to PXC3 with switched off internal supply, Min. 0ft (0m).
- Distance device to next PSU, Max. 1148ft (350m).
- Distance between two PSU operated in parallel Min. 656ft (200m), (Min. 0ft (0m) for the new Siemens power supply modules.).
- Distance between devices, Max. 2297ft (700m).
- Total length of all lines on one line, Max. 3281ft (1000m).

Polarity: Important! – The bus conductors must NOT be inverted. (KNX terminals + and –).

Permissible load [VA] :

Cable length for 24V AC					
AWG	32.8ft	65.6ft	164ft	328ft	656ft
AWG20	48VA	30VA	12VA	6VA	3VA
AWG18	48VA	48VA	20VA	10VA	5VA
AWG16	48VA	48VA	32VA	16VA	8VA
AWG14	48VA	48VA	48VA	24VA	12VA

Permissible load [VA] (SI):

Cable length for AC 24V					
AWG	10m	20m	50m	100m	200m
AWG20	48VA	30VA	12VA	6VA	3VA
AWG18	48VA	48VA	20VA	10VA	5VA
AWG16	48VA	48VA	32VA	16VA	8VA
AWG14	48VA	48VA	48VA	24VA	12VA

KNX PL-Link Technical data

KNX bus :

- Transmission medium (bus cable),TP (twisted pair)
- Baud rate, 9.6 kbps (fixed for TP)
- Bus line polarity, PL+, PL- (not interchangeable)
- Bus terminating resistor, Not required.

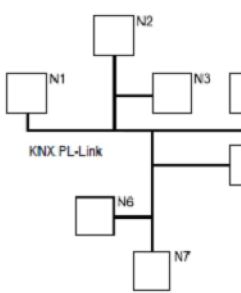
KNX bus cable:

- Cable type, 20AWG two conductor, solid, communication cable (Anixter KNX-TSP20LC-CMP or similar).
- Wire diameter, Min. 0.8 mm (AWG20), Max. 1.0 mm (AWG18).
- Line resistance, 20 to 75 Ω/km.
- Specific capacity, 10 to 100 nF/km at 10 kHz.
- Specific inductivity, 450 to 850 µH/km at 10 kHz.
- Screens, Not required.

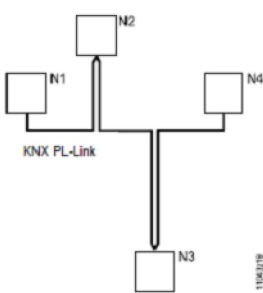
Bus power supply: DXR2 is 30V DC, 50mA for max. 5 KNX devices with 10mA each .

Max. number of devices: 64 devices in a KNX PL-Link network.

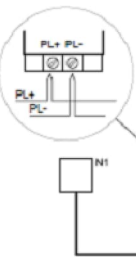
Tree Topology(with stub lines)



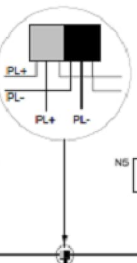
Line Topology (with loops)



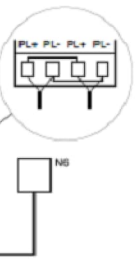
Device with screw terminals



T branch with bus terminals



Device with spring cage terminals



REVISION HISTORY	SIEMENS	Indianapolis Smart Infrastructure	3502 Woodview Trace Indianapolis, IN 46268 USA PHONE: 317 293-8880 FAX: 866 814-3089	IU Research Labs Renovation					440P-388762
				IU PROJECT #20240397,					
				ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE	
				WLH	WLH			01/16/25	
				DXR Wiring Specification2					DWIR2

TEC – ELECTRONIC OUTPUT
WIRING TYPE AND GAUGE REQUIREMENTS

TABLE 1A

CIRCUIT TYPE	CLASS	WIRE TYPE	MAX. DISTANCE	CONDUIT SHARING
INPUT POWER	2	CHECK LOCAL CODES	AS REQUIRED	CHECK LOCAL CODES
DIGITAL OUTPUT	2	CHECK LOCAL CODES	150ft (46 m)	CHECK LOCAL CODES
DIGITAL INPUT	2	#18–22 TP #20 AWG TP	150ft (46 m)	CLASS 1 & 2 CHECK LOCAL CODES
ANALOG INPUT	2	#18–22 TP	100ft (30.5 m)	CLASS 2
ANALOG INPUT THERMISTOR	2	#20 TP	100ft (30.5 m)	CLASS 1 & 2 CHECK CODES
ROOM TEMP. SENSOR	2	6–WIRE RJ11	100ft (30.5 m)	CLASS 2
LAN TRUNK ¹	2	#18–22 AWG TSP	4kft (1220 m)	CLASS 2 ONLY

TEC – PNEUMATIC OUTPUT
WIRING TYPE AND GAUGE REQUIREMENTS

TBBLE 1B

CIRCUIT TYPE	CLASS	WIRE TYPE	MAX. DISTANCE	CONDUIT SHARING
POWER TRUNK (LOW VOLTAGE)	2	CHECK LOCAL CODES	AS REQUIRED	CHECK LOCAL CODES
POWER TRUNK (HIGH VOLTAGE)	1	CHECK LOCAL CODES	AS REQUIRED	CHECK LOCAL CODES
DAMPER OUTPUT (LOW VOLTAGE)	2	CHECK LOCAL CODES	AS REQUIRED	CHECK LOCAL CODES
DAMPER OUTPUT (HIGH VOLTAGE)	1	CHECK LOCAL CODES	AS REQUIRED	CHECK LOCAL CODES
DIGITAL INPUT	2	#18–22 TP	100ft (30.5 m)	CLASS 1 & 2 CHECK LOCAL CODES
ANALOG INPUT	2	#18–22 TP	100ft (30.5 m)	CLASS 2
ROOM TEMP. SENSOR	2	6–WIRE RJ11	100ft (30.5 m)	CLASS 2
LAN TRUNK ¹	2	#18–22 AWG TSP	4kft (1220 m)	CLASS 2 ONLY

TABLE 1A & 1B NOTES:

1. DISTANCE WILL DEPEND ON TRANSFORMER LOCATION.

TEC POWER SOURCE REQUIREMENTS

TEC TYPE	VOLTAGE	LINE FREQUENCY	MAX. POWER
ELECTRONIC OUTPUT	24 VAC +15% –20%	50 / 60 Hz	5.2 VA TO 43.5 VA ¹
PNEUMATIC OUTPUT (LOW VOLTAGE)	24 VAC +15% –20%	50 / 60 Hz	17 VA PLUS DAMPER VA
PNEUMATIC OUTPUT (HIGH VOLTAGE)	115/230 VAC +10% –15%	50 / 60 Hz	17 VA PLUS DAMPER VA

NOTES:

1. VA DEPENDS ON TEC APPLICATION.

DI, AI, AO WIRE SPECIFICATIONS

TABLE 2

SPECIFICATION	WIRE TYPE	
	SHIELDED	UNSHIELDED
CAPACITANCE WIRE TO WIRE	NOT SPECIFIED	NOT SPECIFIED
CAPACITANCE BETWEEN ONE CONDUCTOR WITH OTHER CONDUCTOR CONNECTED TO SHIELD	NOT SPECIFIED	N/A
WIRE LAY	2" MAX.	2" MAX.
AWG	18–22	18–22

LAN TRUNK WIRE

TABLE 3

SPECIFICATION	LENGTH OF TRUNK SECTION	
	4000 FT	10,000 FT
CAPACITANCE WIRE TO WIRE	60pF MAX.	24pF MAX.
CAPACITANCE BETWEEN ONE CONDUCTOR WITH OTHER CONDUCTOR CONNECTED TO SHIELD	100pF MAX.	44pF MAX
WIRE LAY	2" MAX.	2" MAX.
AWG	24	18 MIN.

TABLE 2 & 3 NOTES:

1. OPTIMAL NOISE REDUCTION IS ACHIEVED WITH TIGHTER WIRE LAYS (E.G. 1/2").

GENERAL NOTES:

- COMPLY WITH LOCAL BUILDING CODES.
- SIZE WIRE FOR LOAD, CURRENT, AND VOLTAGE.
- ALL WIRE TO BE APPROVED OR LISTED FOR THE INTENDED APPLICATION BY AGENCIES SUCH AS UL, CSA.
- ALWAYS REFER TO LOCAL CODES FOR CONDUIT SHARING.
- WIRING MUST HAVE INSULATION RATED FOR HIGHEST VOLTAGE CIRCUIT IN CONDUIT.
- PLENUM WIRING MAY BE USED IN PLACE OF ANY LOW VOLTAGE WIRING WITHOUT CHANGES TO LENGTH EXCEPT FOR PMD OR LAN TRUNK. IN CASES WHERE PLENUM WIRE (#18 OR #20 AWG) IS USED FOR PMD OR LAN TRUNK, USE THE REDUCED LENGTHS OF #20 AWG CABLE.
- THE LAN TRUNK MUST BE AN UNINTERRUPTED RUN BETWEEN TEC'S. NO SPLICES ALLOWED.

TEC (ELECTRONIC OUTPUT) DO CONTACT RATING

24 VAC HOT @ 0.5 AMPS

~~WARNING:~~ DO IS NOT A DRY CONTACT!

TEC (PNEUMATIC OUTPUT) DO CONTACT RATING

DO CONTACT RATING NOT SPECIFIED

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
PHONE: 317 293-8880
FAX: 866 814-3089

IU Research Labs Renovation

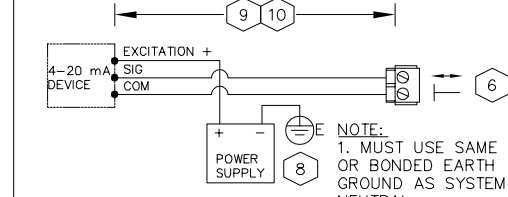
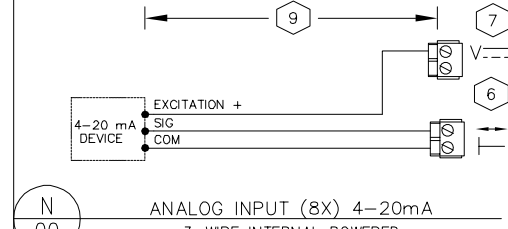
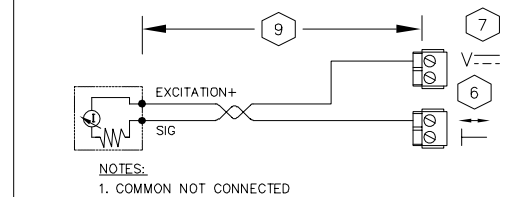
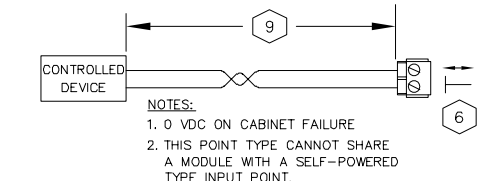
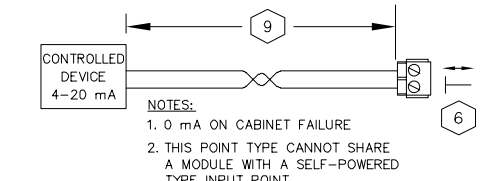
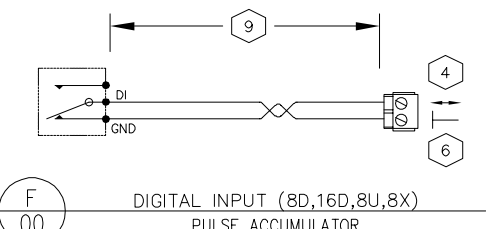
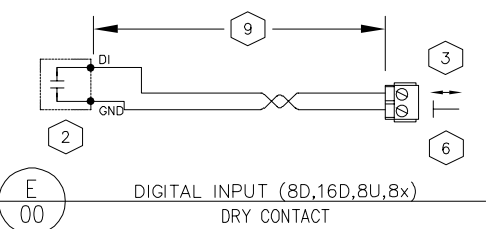
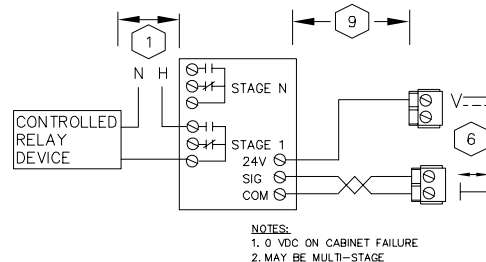
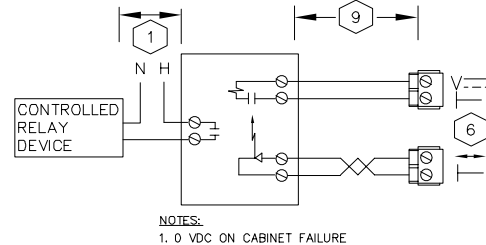
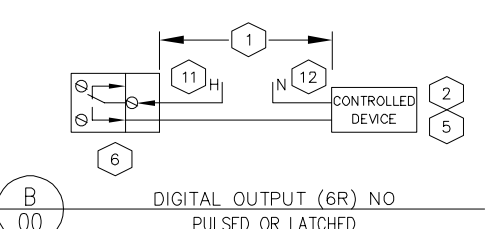
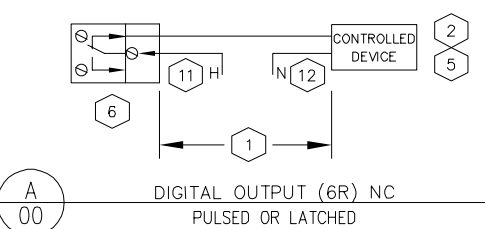
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH			01/16/25

TEC Termination Specification

440P-388762

TTRM



NOTES:

1. MAXIMUM WIRE RUN LENGTHS ARE BASED ON THE CURRENT DRAW AND WIRE GAGE. SEE DRAWING TWIR.

2. SEE CONTROL DRAWINGS FOR NORMAL DE-ENERGIZED CONTACT STATE

3. MAXIMUM CONTACT CLOSURE RATE IS 10 PER SECOND
8D, 16d EXCITATION = 24VDC, 8mA
8U, 8X EXCITATION = 24VDC, 8mA, 20ms, 100mA

4. 8D, 16D MAXIMUM PULSE RATE = 10Hz (50ms PER STATE, 100ms PER PULSE)
8U, 8X MAXIMUM PULSE RATE = 20Hz (25ms PER STATE, 50ms PER PULSE)

5. PXC MODULAR DO CONTACT RATINGS
AC OPERATION:
4A @ 240VAC (RESISTIVE)
3A @ 240VAC (INDUCTIVE)
SIZE 4 MOTOR STARTER
DC OPERATION:
40W @ < 50VDC
20W @ > 50VDC

6. REFER TO PXC MODULAR PANEL FOR ACTUAL POINT ADDRESSES. REFER TO TXMI TERMINATION TABLES FOR ACTUAL TERMINALS FOR EACH PANEL ADDRESS. COMMON TERMINAL MAY BE SHARED BY 2 POINTS.

7. REFER TO DRAWING P1 ON TWIR FOR MAXIMUM CURRENT PROVIDED BY THE 24VDC SENSOR SUPPLY ON P1 BIM OR BUS POWER SUPPLY

8. EXTERNAL POWER SUPPLY CAN EITHER BE A 24VDC POWER SUPPLY OR A 24VAC TRANSFORMER DEPENDING ON THE SENSOR SELECTED. IF NOT AN ISOLATED NC CLASS 2 CIRCUIT THEN POWER SOURCE, NEUTRAL AND PXC MODULAR COMMON MUST BE BOTH CONNECTED TO THE SAME OR BONDED BUILDING APPROVED EARTH GROUND. FOR FURTHER DETAILS SEE EARTH GROUNDING RULES (125-3002) APOGEE WIRING GUIDELINES FOR FIELD PANELS AND EQUIPMENT CONTROLLERS.

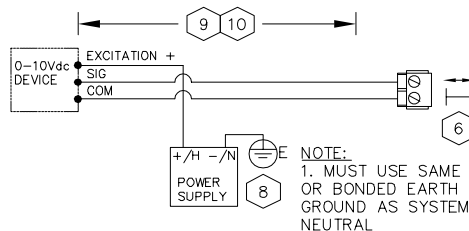
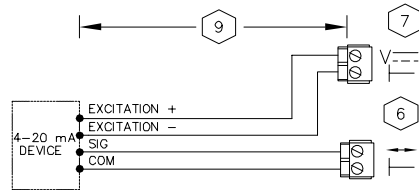
9. 50mA OR LESS - 750ft/230m
50mA TO 100mA - 375ft/115m

10. 100mA TO 150mA - 250ft/76m
150mA TO 200mA - 187ft/57m
200mA TO 250mA - 150ft/46m

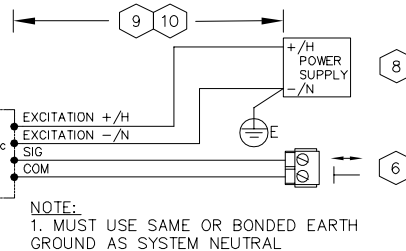
11. WHERE H TERMINAL IS NOT A NEC CLASS 2 CIRCUIT, RELAY COMMON TERMINAL BRANCH CURRENT MUST BE EXTERNALLY LIMITED TO 10A MAXIMUM BY AN NEC APPROVED MEANS. NOT A FUSE.

12. WHERE REQUIRED, N TERMINAL BRANCH CURRENT MUST BE EXTERNALLY LIMITED BY AN NEC APPROVED MEANS.

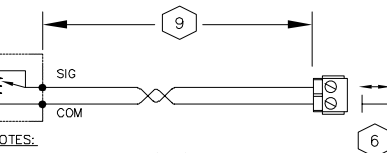
REVISION HISTORY	SIEMENS Indianapolis Smart Infrastructure	IU Research Labs Renovation IU PROJECT #20240397, ENGINEER: WLH, DRAFTER: WLH, CHECKED BY: , INITIAL RELEASE: , LAST EDIT DATE: 01/16/25 TX-I/O Termination Spec.	440P-388762 TTRM1
-------------------------	--	---	--



ANALOG INPUT (8X) 4-20mA
4-WIRE INTERNAL POWERED

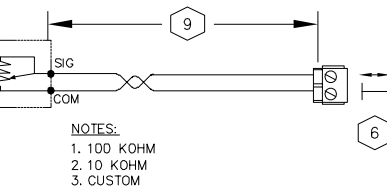


ANALOG INPUT (8U,8X) 0-10VDC
3-WIRE EXTERNAL POWERED



ANALOG INPUT (8U,8X) 0-10VDC
4-WIRE EXTERNAL POWERED

ANALOG INPUT (8X,8U) RTD



ANALOG INPUT (8X,8U) THERMISTOR
3-WIRE INTERNAL POWERED

TXM1 TERMINATION TABLES

1. ALL TXM1 TERMINALS (MEASURING, NEUTRAL, RELAY, SUPPLY) ARE CONNECTED IN THE PLUG-IN I/O MODULE, NOT IN THE TERMINAL BUS.

TXM1.8D, TXM1.16D								
I/O POINT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SYSTEM NEUTRAL ¹	⊥ (-)	1	3	5	7	9	11	13
DIGITAL INPUT	↑ (+)	2	4	6	8	10	12	14

1. NEUTRAL CAN BE CONNECTED TO ANY NEUTRAL TERMINAL ON SAME MODULE AND SEVERAL CAN SHARE SAME NEUTRAL TERMINAL.

TXM1.16D								
I/O POINT	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
SYSTEM NEUTRAL	⊥ (-)	18	20	22	24	26	28	30
DIGITAL INPUT ¹	↑ (+)	19	21	23	25	27	29	31

1. NO PULSE ACCUMULATOR

TXM1.8U, TXM1.8U-ML								
I/O POINT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SYSTEM NEUTRAL	⊥ (-)	2	6	10	14	19	23	27
UNIVERSAL I/O	↑ (+)	4	8	12	16	21	25	29
24V AC/DC ACTUATOR SUPPLY ¹	≈		7		15		24	

1. 24V DC ONLY AVAILABLE WITH BUS CONNECTOR MODULE (BCM) POWERED EXTERNALLY BY DC SUPPLY.

TXM1.8X, TXM1.8X-ML								
I/O POINT	(1)	(2)	(3)	(4)	(5) ¹	(6) ¹	(7) ¹	(8) ¹
SYSTEM NEUTRAL	⊥ (-)	2	6	10	14	19	23	27
UNIVERSAL I/O	↑ (+)	4	8	12	16	21	25	29
24V AC/DC ACTUATOR SUPPLY ²	≈		7		15		24	
24V DC SENSOR SUPPLY ³	==	3		11		20		28

1. 4-20 mA OUTPUT AVAILABLE ON POINTS 5-8 ONLY.

2. 24V DC ONLY AVAILABLE WITH BUS CONNECTOR MODULE (BCM) POWERED EXTERNALLY BY DC SUPPLY.

3. MAY POWER EXTERNAL SENSORS 0.6w (25mA) OR 1.2w (50mA) PER TERMINATION UP TO 2.4w (100mA) MAXIMUM FOR ALL TERMINATIONS.

TXM1.6R, TXM1.6R-M						
I/O POINT	(1)	(2)	(3)	(4)	(5)	(6)
COMMON ¹	↑ (C)	3	9	15	20	26
NORMALLY CLOSED	↗ (NC)	4	10	16	19	25
NORMALLY OPEN	↑ (NO)	2	8	14	21	27

1. COMMONS ARE NOT INTERNALLY CONNECTED.

NOTE: REFER TO TERMINATION SHEET #1 FOR INSTALLATION DETAILS.

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
PHONE: 317 293-8880
FAX: 866 814-3089

IU Research Labs Renovation

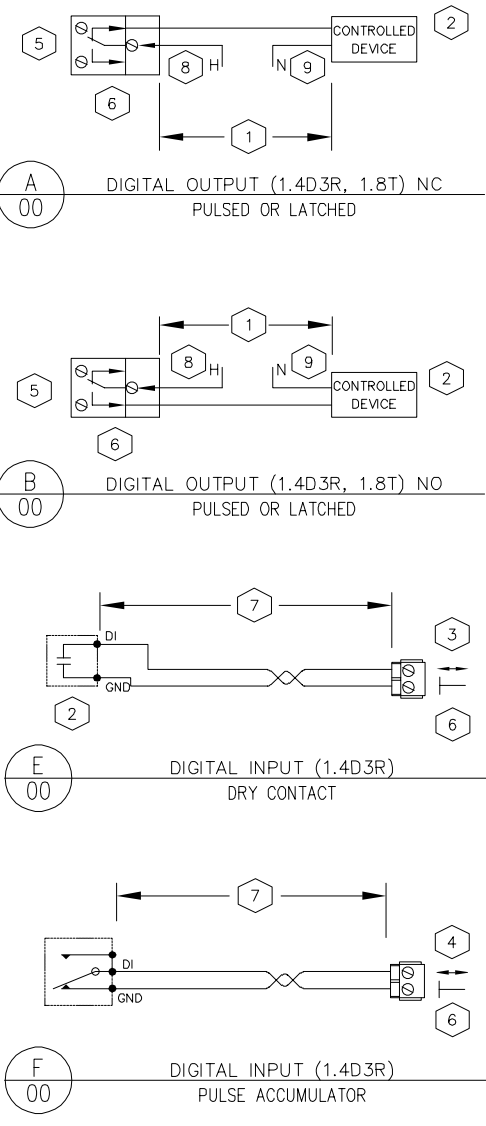
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH			01/16/25

TX-I/O Termination Spec. 2

44OP-388762

TTRM2



- NOTES:
- 1 MAXIMUM WIRE RUN LENGTHS ARE BASED ON THE CURRENT DRAW AND WIRE GAUGE. SEE DRAWING P7WIR.
 - 2 SEE CONTROL DRAWINGS FOR NORMAL DE-ENERGIZED CONTACT STATE
 - 3 MAXIMUM CONTACT CLOSURE RATE IS 10 PER SECOND
 - 4 1.4D3R MAXIMUM PULSE RATE UP TO 10Hz
 - 5 DO CONTACT RATINGS
AC OPERATION:
4A @ 250VAC (RESISTIVE)
3A @ 250VAC (INDUCTIVE)

DC OPERATION:
4A @ 30VDC (RESISTIVE), UL APPLICATIONS
3A @ 30VDC GENERAL PURPOSE
3A @ 30VDC (RESISTIVE)
 - 6 REFER TO PXC7 PANEL FOR ACTUAL POINT ADDRESSES. REFER TO TXM TERMINATION TABLES FOR ACTUAL TERMINALS FOR EACH PANEL ADDRESS. COMMON TERMINAL MAY BE SHARED BY 2 POINTS.
 - 7 50mA OR LESS – 750ft/230m
50mA TO 100mA – 375ft/115m
 - 8 WHERE H TERMINAL IS NOT A NEC CLASS 2 CIRCUIT, RELAY COMMON TERMINAL BRANCH CURRENT MUST BE EXTERNALLY LIMITED TO 10A MAXIMUM BY AN NEC APPROVED MEANS. NOT A FUSE.
 - 9 WHERE REQUIRED, N TERMINAL BRANCH CURRENT MUST BE EXTERNALLY LIMITED BY AN NEC APPROVED MEANS.

TXM1.4D3R			
I/O POINT	(1)	(2)	(3)
SUPPLY	3	9	15
NORMALLY OPEN	↓ (NO)	2	8 14
NORMALLY CLOSED	↗ (NC)	4	10 16

TXM1.4D3R				
I/O POINT	(5)	(6)	(7)	(8)
SYSTEM NEUTRAL ¹	⊥ (-)	26	28	30 32
DIGITAL INPUT	↑ (+)	27	29	31 33

1. TERMINALS 26, 28, 30, 32 ARE SYSTEM NEUTRAL TERMINALS.

THEY ARE INTERCONNECTED, NOT IN THE TERMINAL BASE BUT IN THE PLUG-IN I/O MODULE. WHEN I/O MODULE IS REMOVED, THERE IS NO CONNECTION.

THE SYSTEM NEUTRAL OF A DIGITAL INPUT CAN BE CONNECTED TO ANY SYSTEM NEUTRAL TERMINAL.

TXM1.8T							
I/O POINT	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
SUPPLY ¹	~	2	6	10	14	19	23 27 31
DIGITAL OUTPUT ²	↑ (+)	4	8	12	16	21	25 29 33

1.THE LOAD CAN BE CONNECTED DIRECTLY TO THE CORRESPONDING OUTPUT TERMINALS. NO SEPARATE 24VAC SUPPLY IS REQUIRED.

2. THE TRIAC CLOSSES THE CONTACT TO ⊥ (SYSTEM NEUTRAL).

REVISION HISTORY

SIEMENS

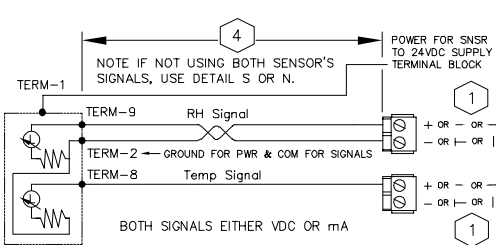
Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
PHONE: 317 293-8880
FAX: 866 814-3089

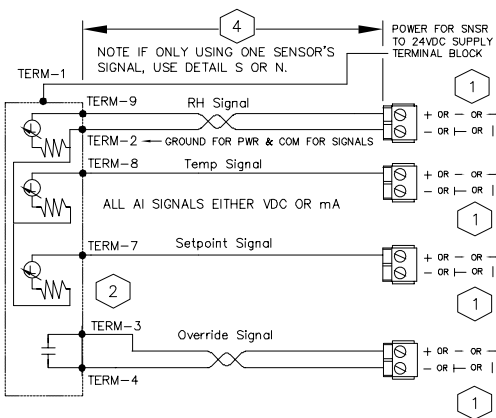
IU Research Labs Renovation				
IU PROJECT #20240397,				
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH			01/16/25
TX-I/O Termination Spec. 3				

44OP-388762

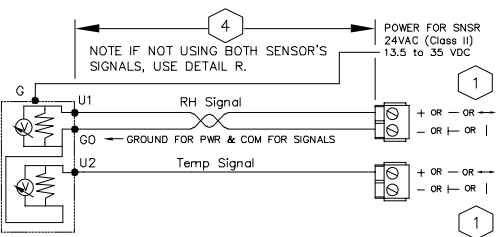
TTRM3



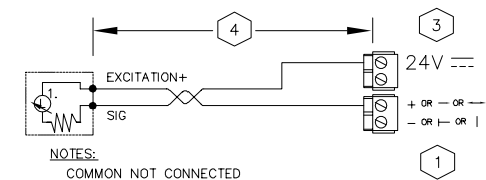
G 00 2 ANALOG INPUT (AI) VDC & mA
4-WIRE For Siemens QFA-series Room Combo Sensor
Note, both signals are active type (either V or Amp).
RH and Temp. Only



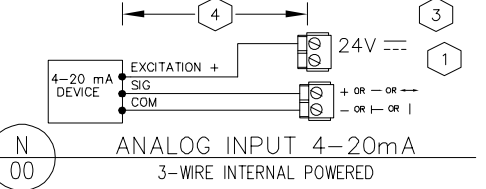
K 00 3 ANALOG INPUT (AI) & 1 DIGITAL INPUT (DI)
7-WIRE For Siemens QFA-series Room Combo Sensor
Note, all AI signals are active type (either V or Amp).
RH, Temp., Setpoint, and Override



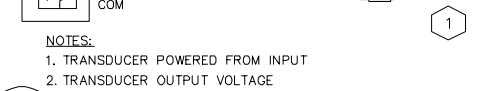
L 00 2 ANALOG INPUT (AI) VDC
4-WIRE For Siemens QFM-series Combo Sensor and QFA-series Outside Air Combo sensor
Note, both signals are active type
RH and Temp.



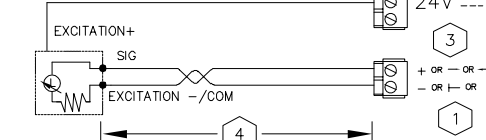
M 00 ANALOG INPUT 4-20 mA
2-WIRE INTERNAL POWERED



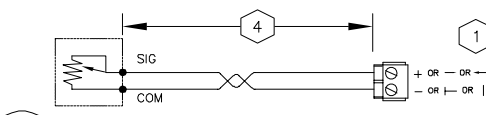
N 00 ANALOG INPUT 4-20mA
3-WIRE INTERNAL POWERED



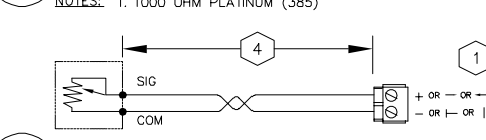
R 00 ANALOG INPUT 0-10 Vdc
SELF POWERED TRANSDUCER



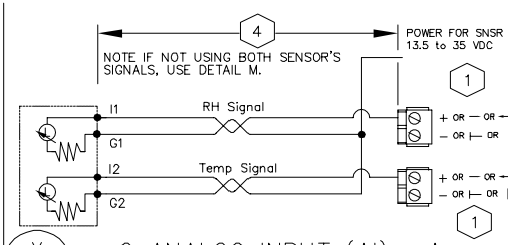
S 00 ANALOG INPUT 0-10 VDC
3-WIRE INTERNAL POWERED



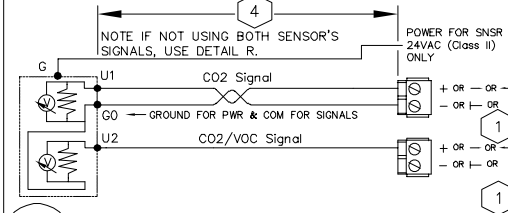
V 00 ANALOG INPUT RTD



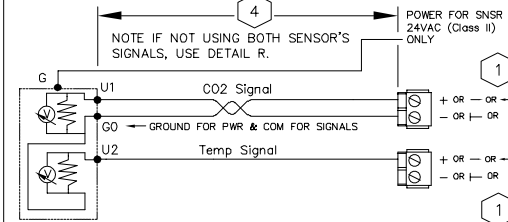
W 00 ANALOG INPUT THERMISTOR
NOTES: 1. 10 KOHM NTC TYPE 2
2. 10 KOHM NTC TYPE 3



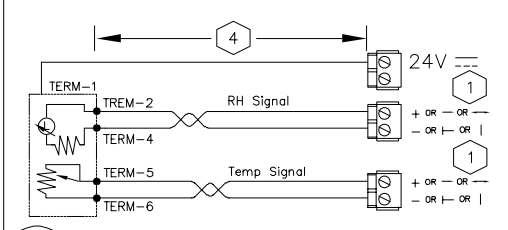
X 00 2 ANALOG INPUT (AI) mA
5-WIRE For Siemens QFM-series COMBO SENSOR and QFA-series Outside Air Combo sensor
Note, RH and Temp are active signals.



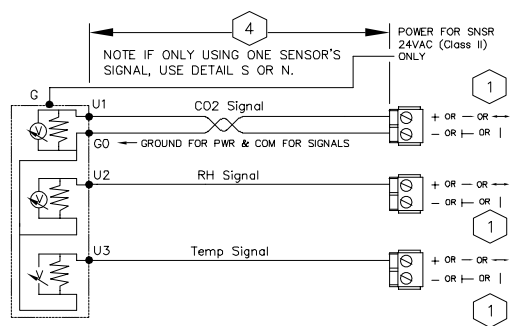
Y 00 2 ANALOG INPUT (AI) VDC
4-WIRE For Siemens QPA-series Combo Sensor and QPM-series Combo sensor
Note, CO2 and CO2/VOC are active signals.



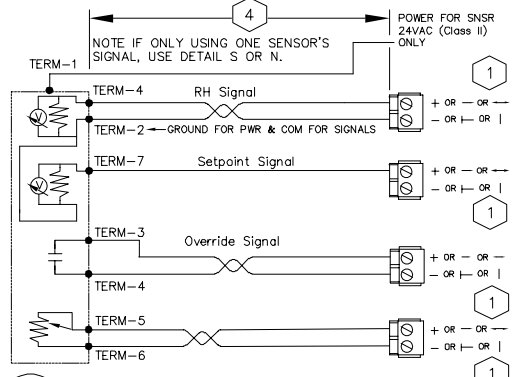
Z 00 2 ANALOG INPUT (AI) VDC
4-WIRE For Siemens QPA-series Combo Sensor and QPM-series Combo sensor
Note, CO2 and TEMP are active signals.



CC 00 ANALOG INPUT 0-10 VDC
5-wire For Siemens QPA-series Combo Sensor
Note, RH signal is active and Temp is passive.



AA 00 3 ANALOG INPUT (AI) VDC
5-WIRE For Siemens QPA-series Combo Sensor and QPM-series Combo sensor
Note, CO2, RH, and Temp. are active signals.



BB 00 2 ACTIVE, 1 PASSIVE & 1 DIGITAL
8-WIRE Siemens QFA-series Room Combo Sensor and QPM-series Combo sensor
Note, RH is either V or Amp, Setpoint is V.
Temp is a passive signal.

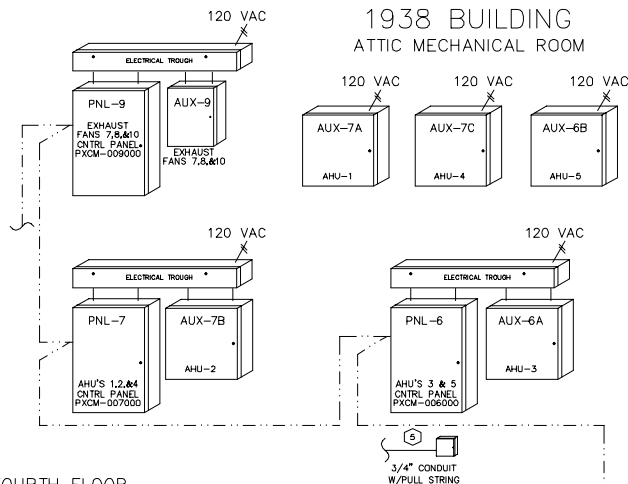
- NOTES:**
- 1 REFER TO SPECIFIC PANEL TERMINATION DRAWINGS FOR DETAILED INFORMATION ON TERMINATIONS
 - 2 TO REDUCE WIRING, YOU MAY JUMPER TERMINALS 3 AND 2, HOWEVER, THE INPUTS ON YOUR CONTROLLER MUST BE REFERENCED TO THE SAME GROUND THAT IS POWERING YOUR SENSOR
 - 3 REFER TO CONTROLLER DRAWING FOR MAXIMUM CURRENT PROVIDED BY THE PXCC 24VDC SENSOR SUPPLY.
 - 4 50mA OR LESS - 750ft/230m
50mA TO 100mA - 375ft/115m

REVISION HISTORY	

SIEMENS		IU Research Labs Renovation		440P-388762	
Indianapolis Smart Infrastructure		IU PROJECT #20240397,		QSST	
3502 Woodview Trace Indianapolis, IN 46268 USA PHONE: 317 293-8880 FAX: 866 814-3089		ENGINEER: WLH DRAFTER: WLH CHECKED BY: WLH INITIAL RELEASE: 01/15/25 LAST EDIT DATE: 01/15/25		Q-Series Sensors Term. Spec.	

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AUX 10	1	567-352	SIEMENS	155 272	#3 PNEU PANEL 24X24X9
PNL 10	1	PXA-ENC34	SIEMENS	149475	ENCLOSURE ASSY 34
	1	PXA-SB115V192VA	SIEMENS	588783	SERVICE BOX 115V, 24VAC, 192VA
PWR 13	1	PSH500A	FUNCTIONAL DEVICES	1208cut143	PS FIVE 100VA C2 120-24VAC ENC

REVISION HISTORY	SIEMENS Indianapolis Smart Infrastructure		3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089		IU Research Labs Renovation IU PROJECT #20240397,					44OP-388762
		Indianapolis Smart Infrastructure		ENGINEER WLH		DRAFTER WLH	CHECKED BY	INITIAL RELEASE 01/17/25	LAST EDIT DATE 01/15/25	001



FOURTH FLOOR

THIRD FLOOR

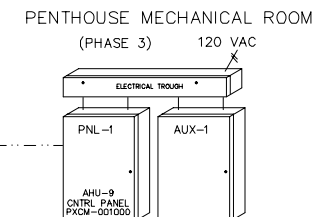
SECOND FLOOR

FIRST FLOOR

INSTALLATION NOTES:

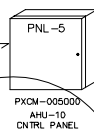
- 1 REFER TO PLANS FOR MORE DETAIL ON CONTROL PANEL LOCATIONS.
- 2 POWER TO IDC PANELS BY DIVISION 26 ELECTRICAL AS STATED IN CONTRACT DOCUMENTS. POWER THAT IS NOT INDICATED IN CONTRACT DOCUMENTS BUT IS REQUIRED FOR BUILDING AUTOMATION SYSTEM (BAS) SHALL BE THE RESPONSIBILITY OF THE CONTROLS INSTALLATION CONTRACTOR (IC).
- 3 CIC TO PROVIDE BARRIER FOR SEPARATION WITHIN THE ELECTRIC TROUGH OF LOW VOLTAGE WIRE AND 120V POWER WIRING.
- 4 REFER TO TX-I/O WIRING SPECIFICATION DRAWING TWR FOR PXXM COMMUNICATION TERMINATION DETAILS.
- 5 CIC TO PROVIDE A DEDICATED 3/4" CONDUIT WITH A PULL STRING FROM IDF/MDF ROOM TO A JUNCTION BOX (MINIMUM 6"x6"x4") LOCATED NEXT TO SIEMENS PANEL WITH A RACEWAY FOR PATCH CABLE CONNECTION TO PXXM CONTROLLER. COORDINATE WITH IU FOR LOCATION OF IDF/MDF ROOM.

1972 BUILDING



ROOF

MECHANICAL ROOM 120

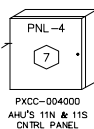


EXISTING AHU-8 (LECTURE ROOM 119)
OWNER TO RENAME AHU-8 AS AHU-10 &
CHANGE NODE 46 TO NODE 5 IN PHASE 2.

BASEMENT LEVEL

- 6 BREAK AND EXTEND EXISTING BLN TRUNK TO ADD PXXM-10 TO SWAIN NETWORK.
- 7 ALTERNATE #1: REMOVE DDC PANEL. REMOVE BAS AND POWER CONDUIT COMPLETE TO ABOVE CEILING.

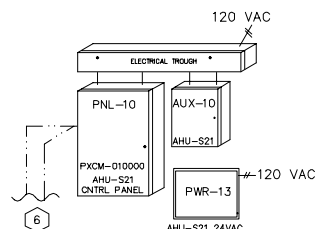
TEACHER LAB SERVER ROOM 011



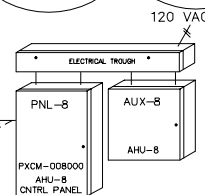
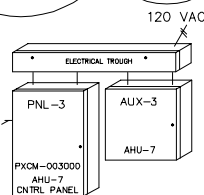
EXISTING STULTZ UNITS
RENAMED AHU-11N & AHU-11S
LOCATION: 1958 BUILDING

SUB-BASEMENT LEVEL

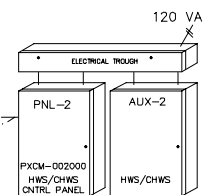
LOCATION S19



MECHANICAL ROOM S14



CHILLER ROOM S14A



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/16/25

Swain Hall Riser

440P-388762

002

- 7 REMOVE TERMINAL BOX. REMOVE TERMINAL BOX CONTROL VALVE AND PIPED ACCESSORIES SUITABLE FOR REUSE. CAREFULLY REMOVE DDC CONTROL AND DAMPER ACTUATOR, CONTROLS CABLING, CONDUIT AND WIREMOLD COMPLETE BACK TO JUNCTION BOX SUITABLE FOR REUSE.
- 8 NEW TERMINAL BOX CONTROLLERS LCMS19027, CAVS20027, & CAVS96027 TO BE ADDED TO PXCM-8 FLN-1.
- 9 NEW TERMINAL BOX CONTROLLERS LCM011027, LCM014027, & CAV011027 TO BE ADDED TO PXCM-8 FLN-2 IF ALTERNATE #1 IS ACCEPTED.

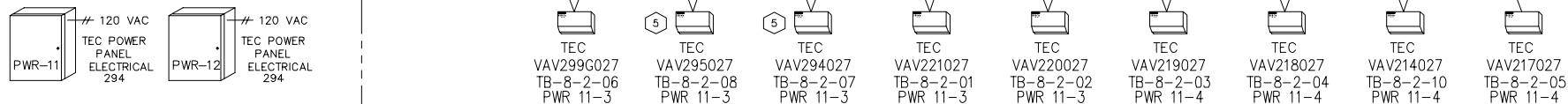
INSTALLATION NOTES:

- 1 REFER TO PLANS FOR MORE DETAIL ON CONTROL PANEL LOCATIONS.
- 2 POWER TO IDC PANELS BY DIVISION 26 ELECTRICAL AS STATED IN CONTRACT DOCUMENTS. POWER THAT IS NOT INDICATED IN CONTRACT DOCUMENTS BUT IS REQUIRED FOR BUILDING AUTOMATION SYSTEM (BAS) SHALL BE THE RESPONSIBILITY OF THE CONTROLS INSTALLATION CONTRACTOR (CIC).
- 3 CIC TO PROVIDE BARRIER FOR SEPARATION WITHIN THE ELECTRIC TROUGH OF LOW VOLTAGE WIRE AND 120V POWER WIRING.
- 4 REFER TO TX-I/O WIRING SPECIFICATION DRAWING TWR FOR PXCM COMMUNICATION TERMINATION DETAILS.
- 5 VAV CONTROLLER INSTALLED IN PHASE 1 WITH TEMPORARY SUPPLY AIR AND CONTROL POWER. UNIT TO BE SWITCHED OVER TO AHU-7 OR AHU-8 IN PHASE 2.
- 6 FCU CONTROLLER INSTALLED IN PHASE 1 TO BE ADDED TO FLN TRUNK IN PHASE 2.

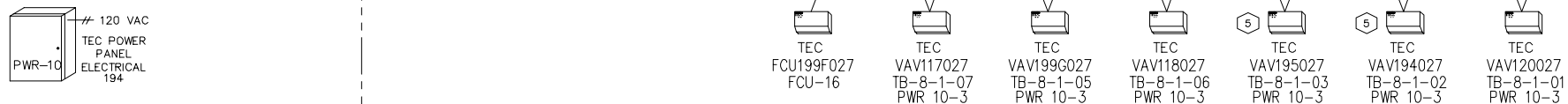
FOURTH FLOOR

THIRD FLOOR

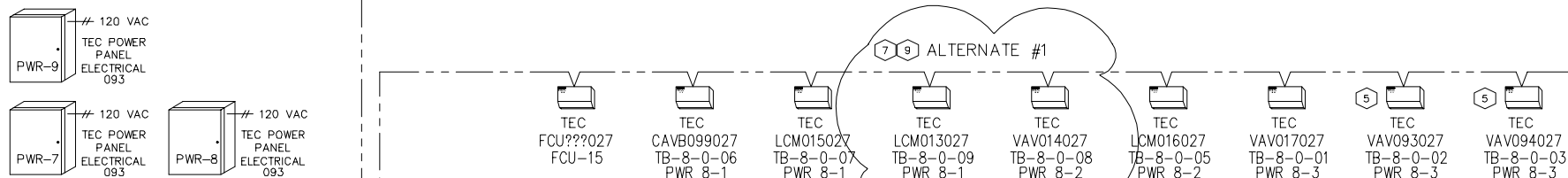
SECOND FLOOR



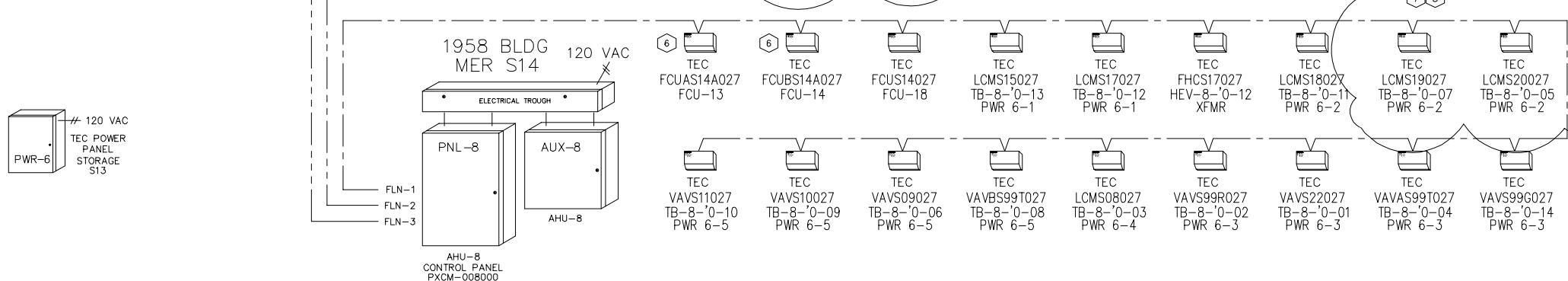
FIRST FLOOR



BASEMENT



SUB-BASEMENT



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

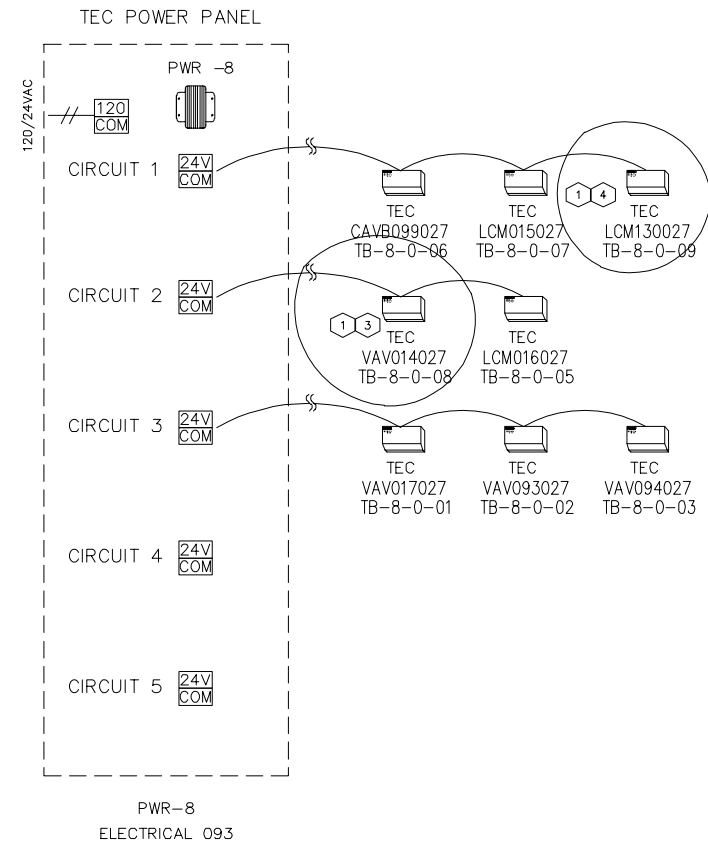
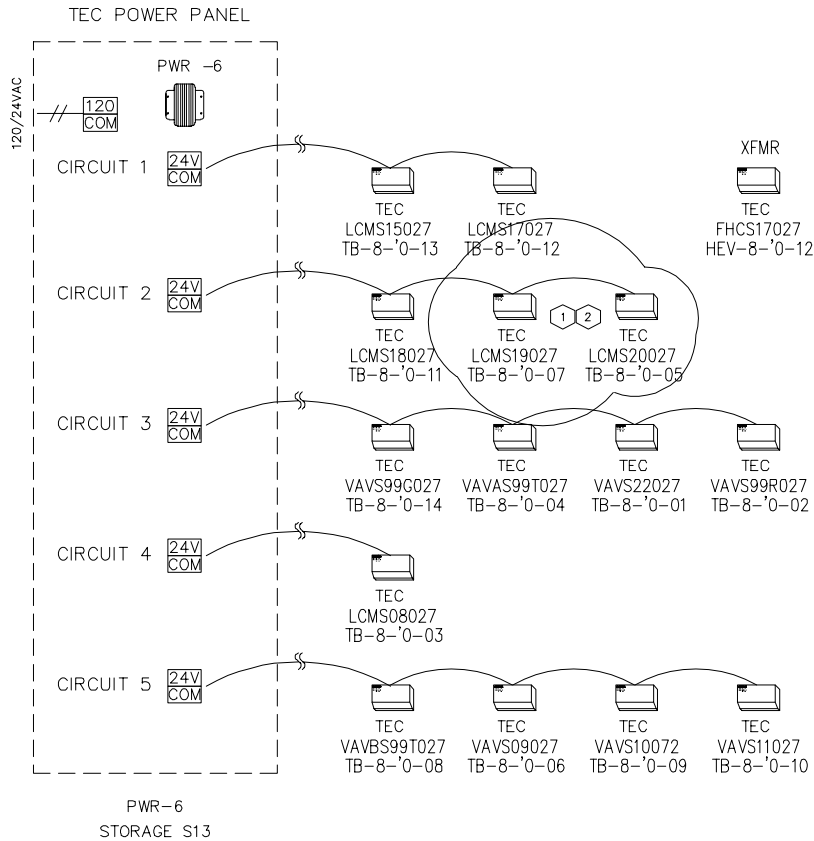
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/15/25

Swain Hall Riser

440P-388762

003

- 1 REMOVE TERMINAL BOX. REMOVE TERMINAL BOX CONTROL VALVE AND PIPED ACCESSORIES SUITABLE FOR REUSE. CAREFULLY REMOVE DDC CONTROL AND DAMPER ACTUATOR, CONTROLS CABLING, CONDUIT AND WIREMOLD COMPLETE BACK TO JUNCTION BOX SUITABLE FOR REUSE.
- 2 NEW TERMINAL BOX CONTROLLERS LCMS19027, CAVS20027, & CAVS96027 TO BE ADDED TO PWR-6 CIRCUIT 2.
- 3 NEW TERMINAL BOX CONTROLLERS LCM011027 & CAV011027 TO BE ADDED TO PWR-8 CIRCUIT 2 IF ALTERNATE #1 IS ACCEPTED.
- 4 NEW TERMINAL BOX CONTROLLER LCM014027 TO BE ADDED TO PWR-8 CIRCUIT 1 IF ALTERNATE #1 IS ACCEPTED.



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/15/25

Swain Hall Riser

44OP-388762

004

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
DPTE 1	1	2641005WD11A1C	SETRA	0608cut003	DP TRAN AIR,1%,5inch ENC
HTTE 1A	1	QFM3171	SIEMENS	149991	DUCT RH & TEMP SENSOR, 4–20mA, 2%
HTTE 1B	1	N/A	N/A	N/A	N/A
RIB 1–4	4	RIBU1C	FUNCTIONAL DEVICES	1208cut013	RIB 120VAC 24VAC/DC SPDT
SPP 1	1	269–062	SIEMENS	N/A	PR269 ACCESSORY, SENSING TUBE
T 1A	1	QFA3212.FWSN	SIEMENS	129104	ROOM RH&T, 1K OHM PT(385), FULL HMI
T 1B	1	N/A	N/A	N/A	N/A
TTE 1	1	QAM2012.045	SIEMENS	149915	DUCT PNT TEMP, PT 1K OHM(385), 18" RIGID
TTE 2–3	2	QAE2012.005	SIEMENS	149919	IMMERSION TMP SNSR, PT 1K OHM(385) 2.5"
TTE 4–5	2	533–377–18	SIEMENS	149263	DCT PNT TMP, 4–20 mA, 30–250F, 18" RIGID
V					SEE VALVE SUBMITTAL
WD 1	1	WD–1B–C	KELE INC	N/A	WATER DETECTOR SPDT W/DEENERGIZED RELAY
Panel Mounted Devices					
RE 1	1	RH2B–UL–AC24VKIT	IDEC	1202cut016	RELAY&SOC,GP DPDT AC24V W/LED

SEQUENCE OF OPERATION:
ALL SETPOINTS TO BE ADJUSTABLE. SETPOINTS TO BE EXPOSED ON GRAPHIC DISPLAY OR HIDDEN BASED ON OWNER REQUEST.

OCCUPIED CYCLE (24 HOURS PER DAY, 365 DAYS PER YEAR):

1. THE UNIT FAN OPERATES CONTINUOUSLY.
2. NORMAL OPERATION MODE:
 - a. RECIRCULATION FAN IS STARTED FROM DDC PANEL OR FROM COMMAND OF FACILITY MANAGEMENT SYSTEM. RECIRCULATION FAN TO NORMALLY RUN CONTINUOUSLY.
 - b. RECIRCULATION FAN SPEED:
–FAN VFC SHALL TO BE CONTROLLED BY ANALOG OUTPUT FAN SPEED SIGNAL AT THE CURRENT SPEED SETTING REQUIRED FROM A PROGRAMMED MINIMUM SPEED SETTING (6.5 VOLTS, ADJ.) UP TO A MAXIMUM VOLTAGE (10 VOLTS) SIGNAL AS REQUIRED. CURRENT SPEED SETTING REQUIRED IS EQUAL TO THE MINIMUM SPEED SETTING PLUS THE COOLING DEMAND SIGNAL. TAB SHALL DOCUMENT AIRFLOWS AT EACH DIFFUSER WHILE AT THE MINIMUM SPEED SETTING AND ADJUST THE MINIMUM SPEED SETTING TO ACHIEVE

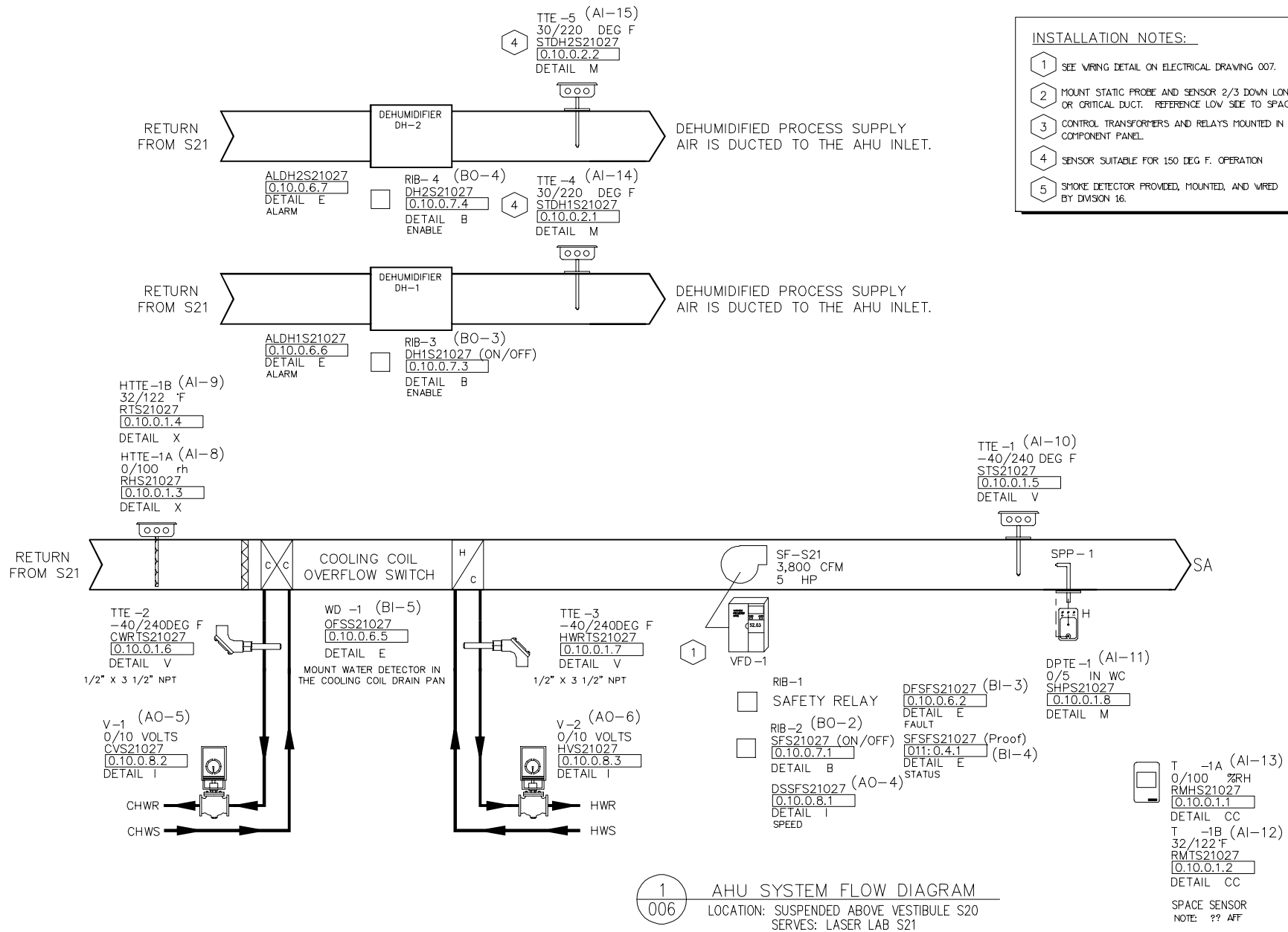
APPROX 30% OF THE TOTAL MAXIMUM SCHEDULED AIRFLOW FROM THE UNIT.
–THE COOLING DEMAND SIGNAL IS CALCULATED BASED ON THE CHILLED WATER VALVE POSITION SIGNAL. CHILLED WATER VALVE POSITION SIGNAL OF 85% (ADJ.) OPEN OR GREATER YIELDS THE MAXIMUM COOLING DEMAND SIGNAL (WHICH WILL YIELD A 10.0 VOLT CURRENT SPEED SETTING REQUIRED). CHILLED WATER VALVE POSITION SIGNAL OF 50% (ADJ.) OPEN OR LESS YIELDS THE MINIMUM COOLING DEMAND SIGNAL (WHICH WILL YIELD A CURRENT SPEED SETTING REQUIRED EQUAL TO THE MINIMUM SPEED SETTING). CHILLED WATER VALVE SIGNAL POSITIONS BETWEEN THESE TWO WILL YIELD A CURRENT SPEED SETTING REQUIRED LINEARLY VARIED BETWEEN THE MINIMUM SPEED SETTING AND THE 10.0 VOLT CURRENT SPEED SETTING REQUIRED WITH THE FAN SPEED SIGNAL TUNED TO VERY SLOWLY CHANGE AND TO NOT OSCILLATE.

- c. VALVE CONTROL:
–MODULATE THE TWO HYDRONIC VALVES TO ACHIEVE THE TEMPERATURE SETPOINT EQUAL TO 72.5 DEGF (ADJ.) AT THE SENSOR WITHIN THE RETURN DUCT (AI–9). WALL–MOUNTED THERMOSTAT (AI–12) IS INITIALLY MONITORING ONLY AND AVAILABLE IF RESEARCHERS PREFER CONTROL TO A SINGLE LOCATION WITHIN THE LAB INSTEAD OF CONTROL TO AN AVERAGE RETURN AIR TEMPERATURE IN THE DUCTWORK.
–CHW VALVE BEGINS TO MODULATE OPEN AT TEMPERATURE SETPOINT PLUS 0.21 DEGF (ADJ.). CONTROL THE SENSOR READING TO BE NO WARMER THAN TEMPERATURE SETPOINT PLUS 0.50 DEGF (ADJ.).
–CHW VALVE IS FULLY CLOSED AT SENSOR READINGS OF LESS THAN TEMPERATURE SETPOINT PLUS 0.20 DEGF (ADJ.).
–HW VALVE BEGINS TO MODULATE OPEN AT TEMPERATURE SETPOINT MINUS 0.21 DEGF (ADJ.). CONTROL THE SENSOR READING TO BE NO COOLER THAN TEMPERATURE SETPOINT MINUS 0.50 DEGF (ADJ.).
–HW VALVE IS FULLY CLOSED AT SENSOR READINGS OF GREATER THAN TEMPERATURE SETPOINT MINUS 0.20 DEGF (ADJ.).
–TUNE THE VALVE CONTROL LOOPS AND UPDATE TIMES TO AVOID TEMPERATURE OSCILLATIONS OF GREATER THAN 0.10 DEGF PER SECOND AS MEASURED AT THE DUCT MOUNTED SENSOR (AI–10).
- d. DEHUMIDIFIER CONTROL:
–DEHUMIDIFIERS HAVE INTEGRAL CONTROLLERS TO CONTROL THE PROCESS AIR FAN, THE REACTIVATION AIR FAN, THE DESICCANT WHEEL, AND THE REACTIVATION HEATER.
–WHEN THE SPACE RH (AI–13) IS LESS 35% RH (ADJ.) BOTH DEHUMIDIFERS ARE OFF.
–WHEN THE SPACE RH IS MORE THAN 35% RH (ADJ.) AND LESS 40% RH (ADJ.) THE LEAD DEHUMIDIFER IS ON AND THE LAG DEHUMIDIFER IS OFF.
–WHEN THE SPACE RH (AI–13) IS GREATER 40% RH (ADJ.) BOTH DEHUMIDIFERS ARE ON AND OPERATE IN PARALLEL.
–DH–1 AND DH–2 AUTOMATICALLY ROTATE AS LEAD / LAG WITH EVERY START UP FROM BOTH UNITS BEING COMMANDED OFF. DH–1 AND DH–2 AUTOMATICALLY ROTATE AS LEAD / LAG ON THE FIRST TUESDAY OF EACH MONTH. IF A DH FAILS TO START (AS INDICATED BY A LACK OF AT LEAST A 10 DEGF (ADJ.) TEMPERATURE RISE IN THE DISCHARGE AIR TEMPERATURE FOR A PERIOD EXCEEDING FIVE MINUTES (ADJ.)) THEN ENABLE THE LAG DH TO START.

3. SET UP AND START AN HOURLY RELATIVE HUMIDITY SENSOR READING TREND FOR HISTORICAL PURPOSES OF THE RH SENSOR. SET UP AND START AN HOURLY TEMPERATURE SENSOR READING TREND FOR HISTORICAL PURPOSES OF AT THREE TEMPERATURE SENSORS.
4. ALARMS
–ALARM AT THE OWS ANYTIME THE SPACE RELATIVE HUMIDITY EXCEEDS 45% RH (ADJ.) FOR A PERIOD OF TEN MINUTES (ADJ.).
–AT THE OWS ANYTIME THE DISCHARGE AIR TEMPERATURE FROM A DH CALLED TO OPERATE EXCEEDS 140 DEGF (ADJ.) FOR A PERIOD OF FIVE MINUTES (ADJ.).

UNOCCUPIED CYCLE (NONE):
THERE IS NO UNOCCUPIED CYCLE FOR THE AHU NOR FOR THE DEHUMIDIFIERS.

REVISION HISTORY		<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>		<div>3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089</div>		IU Research Labs Renovation IU PROJECT #20240397,				440P-388762	
						ENGINEER WLH		DRAFTER WLH		CHECKED BY	INITIAL RELEASE 01/17/25
						Swain AHU-S21 Control					



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

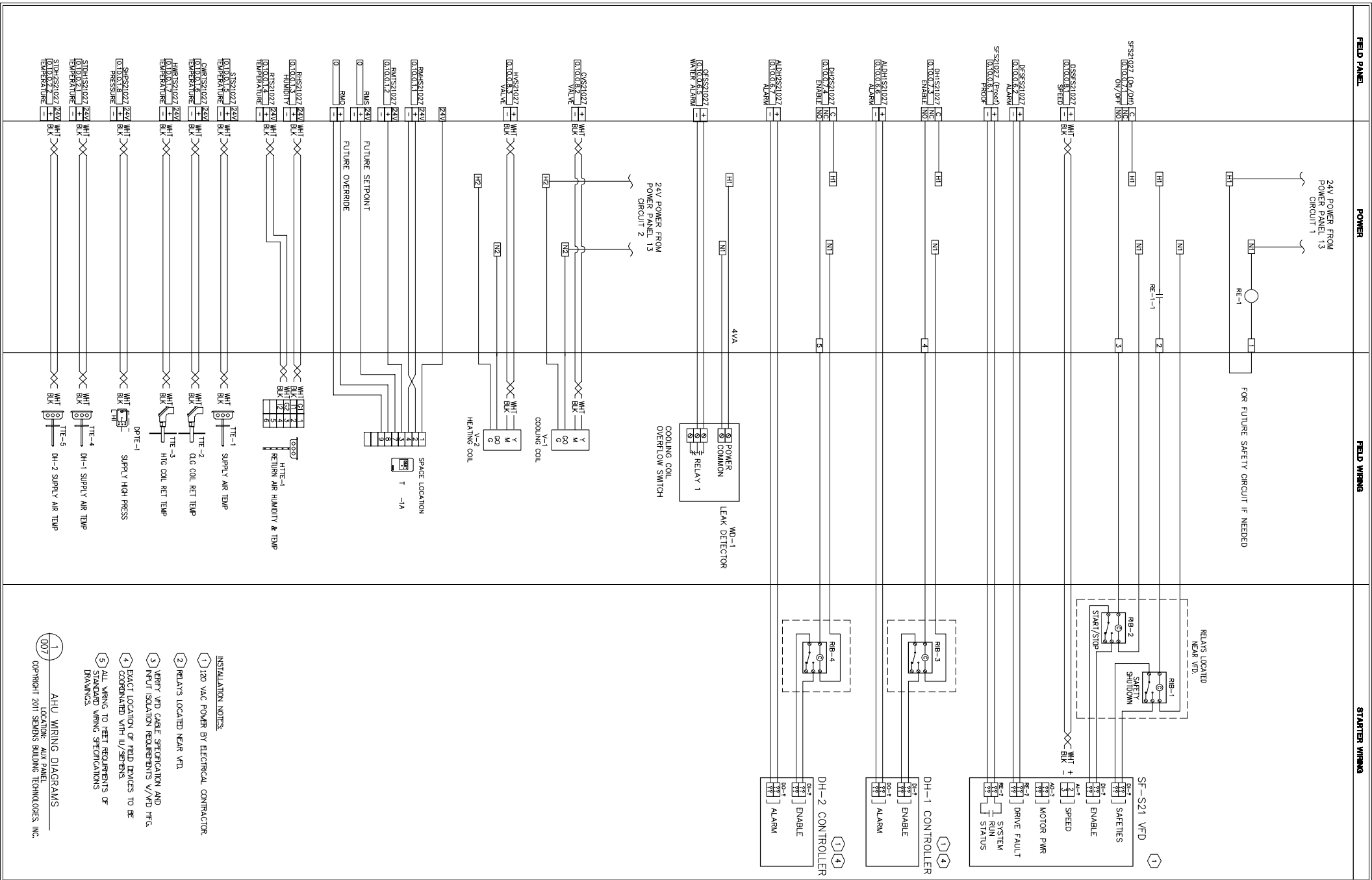
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/15/25

Swain AHU-S21 Control

440P-388762

006



REVISION HISTORY

1	007	AHU WIRING DIAGRAMS LOCATION: AUX PANEL
---	-----	--

SIEMENS

Indianapolis
Smart Infrastructure

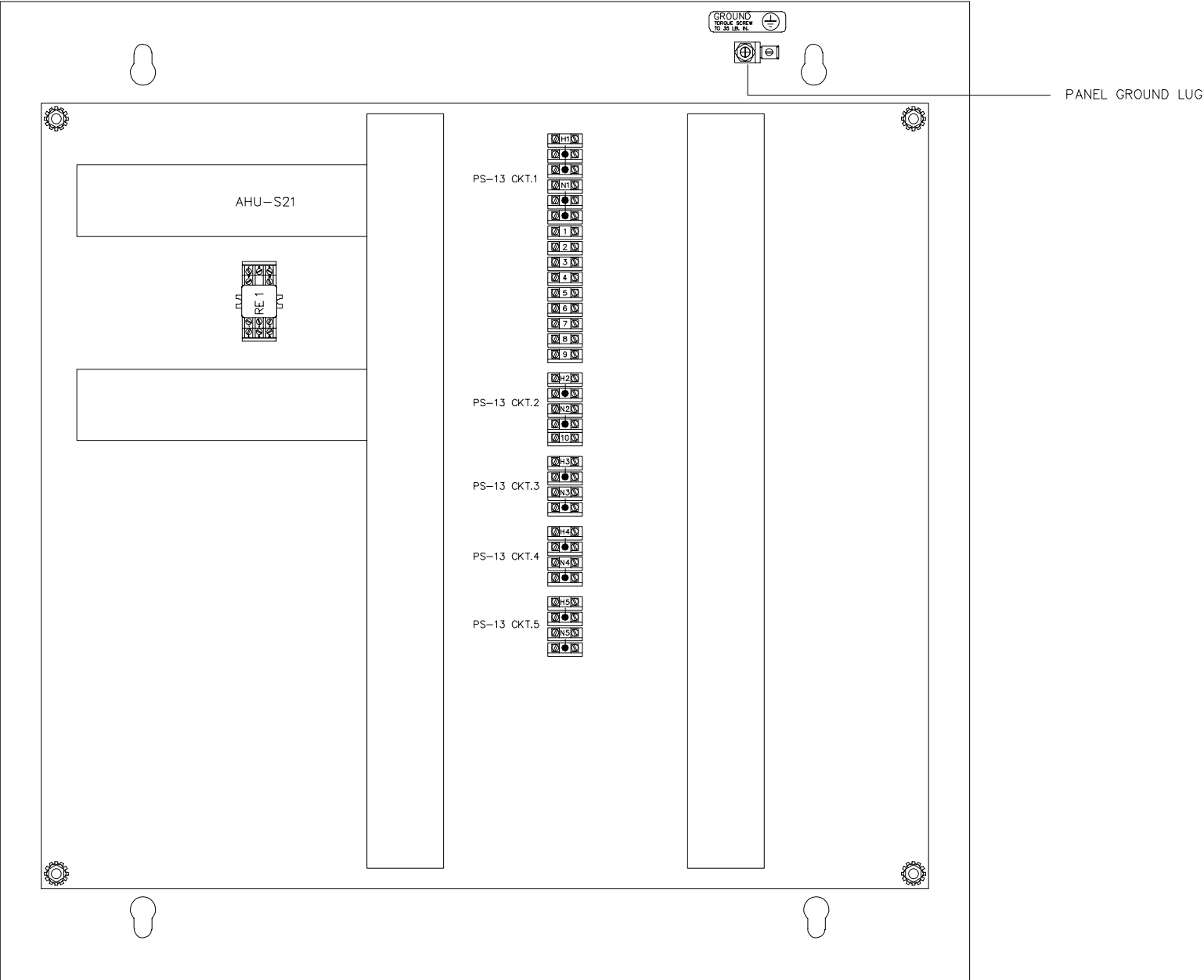
3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/16/25

Swain AHU-S21 Control



1
008 AHU_COMPONENT PANEL
LOCATION: REFER TO FLOOR PLAN

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Swain AHU-S21 Control

440P-388762

008

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
DPTE 1	1	2641005WD11A1C	SETRA	0608cut003	DP TRAN AIR,1%,5inch ENC
HTTE 1A	5	QFM3171	SIEMENS	149991	DUCT RH & TEMP SENSOR, 4–20mA, 2%
HTTE 1B	5	N/A	N/A	N/A	N/A
RIB 2	1	RIBU1C	FUNCTIONAL DEVICES	1208cut013	RIB 120VAC 24VAC/DC SPDT
SPP 1	1	269–062	SIEMENS	N/A	PR269 ACCESSORY, SENSING TUBE
T 1A	5	QFA3171	SIEMENS	149992	ROOM RH & TEMP SENSOR, 4–20mA, 2%
	5	AQY2010	SIEMENS	149209	REMOTE SENSING CABLE, QFA31XX, 10'
T 1B	5	N/A	N/A	N/A	N/A
TTE 1–2	2	QAM2012.045	SIEMENS	149915	DUCT PNT TEMP, PT 1K OHM(385), 18" RIGID
V					SEE VALVE SUBMITTAL

SEQUENCE OF OPERATION:
ALL SETPOINTS TO BE ADJUSTABLE. SETPOINTS TO BE EXPOSED ON GRAPHIC DISPLAY OR HIDDEN BASED ON OWNER REQUEST.

OCCUPIED CYCLE (24 HOURS PER DAY, 365 DAYS PER YEAR):

1. THE UNIT FAN OPERATES CONTINUOUSLY.

2. NORMAL OPERATION MODE:

a. RECIRCULATION FAN IS STARTED FROM DDC PANEL OR FROM COMMAND OF FACILITY MANAGEMENT SYSTEM. RECIRCULATION FAN TO NORMALLY RUN CONTINUOUSLY.

b. RECIRCULATION FAN SPEED:

–FAN VFC SHALL TO BE CONTROLLED BY ANALOG OUTPUT FAN SPEED SIGNAL AT THE CURRENT SPEED SETTING REQUIRED FROM A PROGRAMMED MINIMUM SPEED SETTING (6.5 VOLTS, ADJ.) UP TO A MAXIMUM VOLTAGE (10 VOLTS) SIGNAL AS REQUIRED. CURRENT SPEED SETTING REQUIRED IS EQUAL TO THE MINIMUM SPEED SETTING PLUS THE COOLING DEMAND SIGNAL. TAB SHALL DOCUMENT AIRFLOWS AT EACH DIFFUSER WHILE AT THE MINIMUM SPEED SETTING AND ADJUST THE MINIMUM SPEED SETTING TO ACHIEVE APPROX 30% OF THE TOTAL MAXIMUM SCHEDULED AIRFLOW FROM THE UNIT.

–THE COOLING DEMAND SIGNAL IS CALCULATED BASED ON THE CHILLED WATER VALVE POSITION SIGNAL. CHILLED WATER VALVE POSITION SIGNAL OF 85% (ADJ.) OPEN OR GREATER YIELDS THE MAXIMUM COOLING DEMAND SIGNAL (WHICH WILL YIELD A 10.0 VOLT CURRENT SPEED SETTING REQUIRED). CHILLED WATER VALVE POSITION SIGNAL OF 50% (ADJ.) OPEN OR LESS YIELDS THE MINIMUM COOLING DEMAND SIGNAL (WHICH WILL YIELD A CURRENT SPEED SETTING REQUIRED EQUAL TO THE MINIMUM SPEED SETTING). CHILLED WATER VALVE SIGNAL POSITIONS BETWEEN THESE TWO WILL YIELD A CURRENT SPEED SETTING REQUIRED LINEARLY VARIED BETWEEN THE MINIMUM SPEED SETTING AND THE 10.0 VOLT CURRENT SPEED

SETTING REQUIRED WITH THE FAN SPEED SIGNAL TUNED TO VERY SLOWLY CHANGE AND TO NOT OSCILLATE.

OPTICAL TABLE ENCLOSURE:
OCCUPIED CYCLE (24 HOURS PER DAY, 365 DAYS PER YEAR):

- MODULATE THE TWO HYDRONIC VALVES TO ACHIEVE THE TEMPERATURE SETPOINT EQUAL TO 73.0 DEGF (ADJ.) AT THE SENSOR WITHIN THE ENCLOSURE (AI–6).
–CHW VALVE BEGINS TO MODULATE OPEN AT TEMPERATURE SETPOINT PLUS 0.21 DEGF(ADJ.). CONTROL THE SENSOR READING TO BE NO WARMER THAN TEMPERATURE SETPOINT PLUS 0.50 DEGF (ADJ.).
–CHW VALVE IS FULLY CLOSED AT SENSOR READINGS OF LESS THAN TEMPERATURE SETPOINT PLUS 0.20 DEGF (ADJ.).
–HW VALVE BEGINS TO MODULATE OPEN AT TEMPERATURE SETPOINTMINUS 0.21 DEGF (ADJ.). CONTROL THE SENSOR READING TO BE NO COOLER THAN TEMPERATURE SETPOINT MINUS 0.50 DEGF (ADJ.).
–HW VALVE IS FULLY CLOSED AT SENSOR READINGS OF GREATER THAN TEMPERATURE SETPOINT MINUS 0.20 DEGF (ADJ.).
- TUNE THE CONTROL LOOP AND UPDATE TIMES TO AVOID TEMPERATURE OSCILLATIONS OF GREATER THAN 0.10 DEGF PER SECOND AS MEASURED AT THE DUCT MOUNTED SENSOR (AI–4).
- SET UP AND START AN HOURLY RELATIVE HUMIDITY SENSOR READING TREND FOR HISTORICAL PURPOSES OF BOTH RH SENSORS. SET UP AND START AN HOURLY TEMPERATURE SENSOR READING TREND FOR HISTORICAL PURPOSES OF BOTH TEMPERATURE SENSORS.

UNOCCUPIED CYCLE (NONE):
THERE IS NO UNOCCUPIED CYCLE.

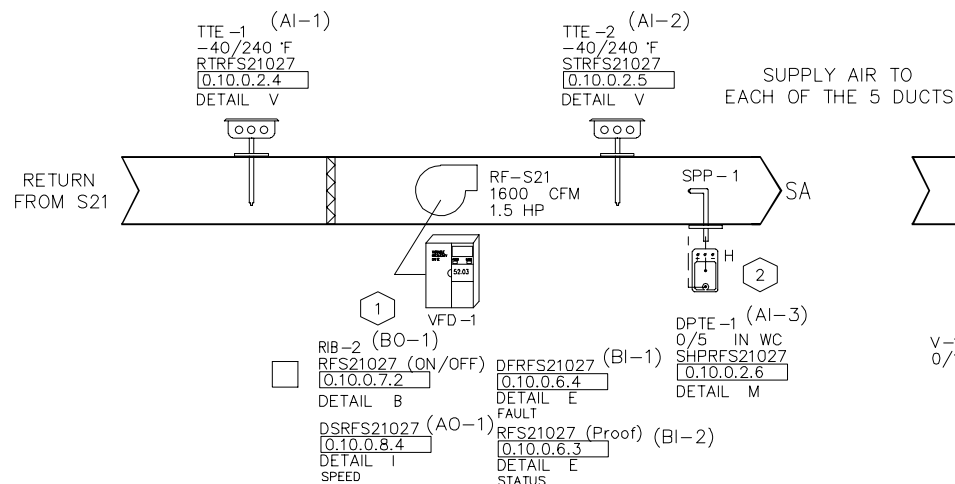
REVISION HISTORY		<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>		<div>3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089</div>		IU Research Labs Renovation				440P-388762	
						IU PROJECT #20240397,					
						ENGINEER WLH	DRAFTER WLH	CHECKED BY	INITIAL RELEASE 01/17/25	LAST EDIT DATE 01/16/25	009
						Swain Optical Enclosure Control					

	(AI-7)	(AI-6)	(AI-5)	(AI-4)	(AO-2)	(AO-3)
	T-1A	T-1B	HTTE-1A	HTTE-1B	V-1	V-2
OPTICAL TABLE ENCLOSURE #1	RMHOTE1027 [0.10.0.2.7] DETAIL G	RMTOTE1027 [0.10.0.2.8] DETAIL G	SHOTE1027 [0.10.0.4.3] DETAIL X	STOTE1027 [0.10.0.4.4] DETAIL X	CVOTE1027 [0.10.0.8.7] DETAIL I	HVOTE1027 [0.10.0.8.8] DETAIL I
OPTICAL TABLE ENCLOSURE #2	RMHOTE1027 [0.10.0.2.7] DETAIL G	RMTOTE1027 [0.10.0.2.8] DETAIL G	SHOTE1027 [0.10.0.4.3] DETAIL X	STOTE1027 [0.10.0.4.4] DETAIL X	CVOTE1027 [0.10.0.8.7] DETAIL I	HVOTE1027 [0.10.0.8.8] DETAIL I
OPTICAL TABLE ENCLOSURE #3	RMHOTE1027 [0.10.0.2.7] DETAIL G	RMTOTE1027 [0.10.0.2.8] DETAIL G	SHOTE1027 [0.10.0.4.3] DETAIL X	STOTE1027 [0.10.0.4.4] DETAIL X	CVOTE1027 [0.10.0.8.7] DETAIL I	HVOTE1027 [0.10.0.8.8] DETAIL I
OPTICAL TABLE ENCLOSURE #4	RMHOTE1027 [0.10.0.2.7] DETAIL G	RMTOTE1027 [0.10.0.2.8] DETAIL G	SHOTE1027 [0.10.0.4.3] DETAIL X	STOTE1027 [0.10.0.4.4] DETAIL X	CVOTE1027 [0.10.0.8.7] DETAIL I	HVOTE1027 [0.10.0.8.8] DETAIL I
OPTICAL TABLE ENCLOSURE #5	RMHOTE1027 [0.10.0.2.7] DETAIL G	RMTOTE1027 [0.10.0.2.8] DETAIL G	SHOTE1027 [0.10.0.4.3] DETAIL X	STOTE1027 [0.10.0.4.4] DETAIL X	CVOTE1027 [0.10.0.8.7] DETAIL I	HVOTE1027 [0.10.0.8.8] DETAIL I

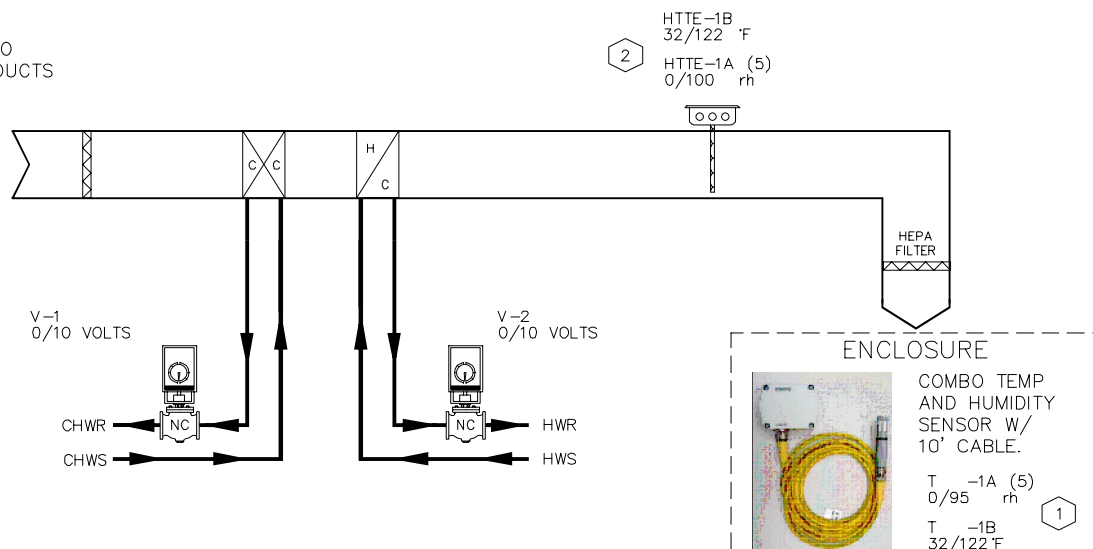
INSTALLATION NOTES:

1 SENSORS ARE PROVIDED "WIRED LOOSE" TO THE RESEARCHERS. LOCATE AND INSTALL THE SENSORS WITHIN THE ENCLOSURE AS DIRECTED BY THE RESEARCHER. COORDINATE DIRECTLY WITH PROFESSOR DEBAYAN MITRA TO ROUTE INTO THE ENCLOSURE AND MOUNT THE BAS SENSORS INTO EACH ENCLOSURE AND TO PROVIDE AN ADEQUATE LENGTH OF SENSOR WIRE TO ALLOW FOR MAINTENANCE AND RESEARCH ACTIVITIES. PROVIDE VELCRO WIRE SUPPORT SYSTEM AS DIRECTED BY THE RESEARCHER.

2 MOUNT DUCT SENSORS A MINIMUM OF 5'-0" DOWNSTREAM OF THE LAST COIL.



1
010 S21 RECIRCULATION FAN
SERVES (5) OPTICAL TABLE ENCLOSURES



2
010 OPTICAL TABLE ENCLOSURE
TYPICAL OF 5

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

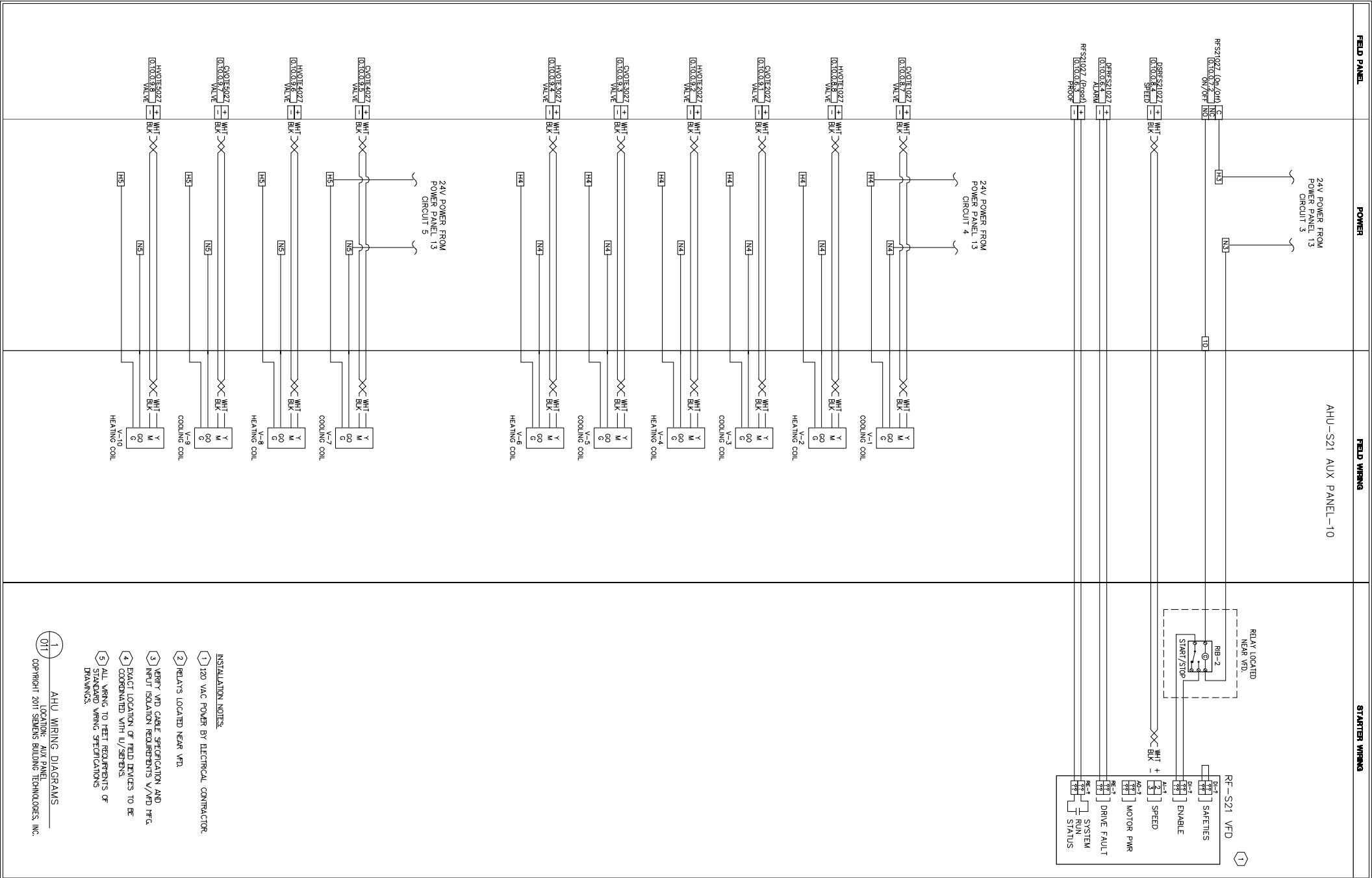
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Swain Optical Enclosure Control

440P-388762

010



INSULATION NOTES:

- 120 VAC POWER BY ELECTRICAL CONTRACTOR.
- RELAYS LOCATED NEAR VFD.
- VERIFY VFD CABLE SPECIFICATION AND INPUT ISOLATION REQUIREMENTS V/VFD IF G.
- EXACT LOCATION OF FIELD DEVICES TO BE COORDINATED WITH U/S/SDNS.
- ALL WIRING TO MEET REQUIREMENTS OF STANDARD WIRING SPECIFICATIONS DRAWINGS.

1
011
AHU WIRING DIAGRAMS
LOCATION: AUX PANEL
COPYRIGHT 2011 SIEMENS BUILDING TECHNOLOGIES, INC.

REVISION HISTORY		SIEMENS		3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089		IU Research Labs Renovation IU PROJECT #20240397,					440P-388762							
						<table><tr><td>ENGINEER</td><td>DRAFTER</td><td>CHECKED BY</td><td>INITIAL RELEASE</td><td>LAST EDIT DATE</td></tr><tr><td>WLH</td><td>WLH</td><td>MED</td><td>01/17/25</td><td>01/16/25</td></tr></table>					ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE	WLH	WLH	MED
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE														
WLH	WLH	MED	01/17/25	01/16/25														
		Indianapolis Smart Infrastructure		Swain Optical Enclosure Control														
© COPYRIGHT 1994-25 Indianapolis All Rights Reserved		C:\JOBS\440P-388762\IU_SWAIN_SIMON_CHEMISTRY\MDT\SW_ENCLOSUREA.DWG																

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
D					SEE DAMPER SUBMITTAL
DPS 1	1	AFS-460-DSS	KELE INC	N/A	2-12in SWITCH W/2 SPST CONTACTS
DPTE 1	1	2641010WD11A1C	SETRA	0608cut003	DP TRAN AIR,1%,10" ENC
DPTE 3	1	2641005WB11A1C	SETRA	0608cut003	DP TRAN AIR,1%,+/-5" ENC
EF 8	1	N/A	N/A	N/A	N/A
SPP 1	1	A-489	DWYER INST	A(PRS TIP)	4" straight static pressure tip w/flange
SPP 3	1	A-489	DWYER INST	A(PRS TIP)	4" straight static pressure tip w/flange
Panel Mounted Devices					
RE 4	1	RH2B-UL-AC24VKIT	IDEC	1202cut016	RELAY&SOC,GP DPDT AC24V W/LED
Existing Equipment To Remain					
AE 2	1	GMA126.1U	SIEMENS	154004	2PT SR 24V,62LBIN/S/PLM
AFMS 2	1	FBO	N/A	N/A	FURNISHED BY OTHERS
DPTE 2	1	2641005WB11A1C	SETRA	0608cut003	DP TRAN AIR,1%,+/-5" ENC
RIB 3-4	2	RIBU1C	FUNCTIONAL DEVICES	1208cut013	RIB 120VAC 24VAC/DC SPDT
SPP 2	1	A-489	DWYER INST	A(PRS TIP)	4" straight static pressure tip w/flange

SEQUENCE OF OPERATION:

ALL SETPOINTS TO BE ADJUSTABLE. SETPOINTS TO BE EXPOSED ON GRAPHIC DISPLAY OR HIDDEN BASED ON OWNER REQUEST.

NORMAL OPERATION MODE:

- EXHAUST FAN IS STARTED FROM DDC PANEL OR FROM COMMAND OF FACILITY MANAGEMENT SYSTEM. EXHAUST FAN TO NORMALLY RUN CONTINUOUSLY.
- STARTUP: ON AIR-HANDLING UNIT AHU-8 STARTUP, THE ASSOCIATED EXHAUST FAN IS ENABLED WHEN REACHING AN ADJ. PERCENTAGE OF THE AIRFLOW TRACKING DIFFERENTIAL SETPOINT (INDICATING THAT THE AHU IS PULLING IN OUTDOOR AIR AND NOT JUST IN A 100% RECIRCULATION MODE). ENGAGE VFC AND SIMULTANEOUSLY BEGIN TO OPEN EXHAUST FAN ISOLATION DAMPER. IF ISOLATION DAMPER IS NOT FULLY OPEN WITHIN 30 SECONDS THEN DISABLE EXHAUST FAN AND SIGNAL AN ALARM.
- EXHAUST FAN SPEED:
 - DISABLE ANY EXISTING FAN STATIC PRESSURE RESET CONTROL THAT EXISTS WITHIN THE PROGRAMMING.

-ADD NEW DUCT STATIC PRESSURE CONTROL LOGIC, LOOKING AT BOTH REMOTE DUCT STATIC PRESSURE SENSORS, AND CONTROLLING THE FAN SPEED TO THE MOST NEEDY OF THE TWO SETPOINTS. EACH SENSOR SHALL HAVE IT'S OWN INDIVIDUAL SETPOINT. DISPLAY THE INDIVIDUAL SETPOINTS AND INDIVIDUAL PRESSURE READINGS AND WHICH IS THE GOVERNING SENSOR ON THE GRAPHICS.

-EXISTING STATIC PRESSURE SENSOR #1 TO FUNCTION WITH EXHAUST FAN VFC CONTROL LOOP TO MODULATE EXHAUST FAN SPEED TO ACHIEVE DUCT STATIC PRESSURE INITIALLY SET AT 0.30" W.G. (ADJ, FINAL SETPOINT BY TAB BASED ON BASEMENT LEVEL AFCV DAMPER POSITIONS WHILE AT MAX CFM SETPOINTS).

-NEW STATIC PRESSURE SENSOR #2 TO FUNCTION WITH EXHAUST FAN VFC CONTROL LOOP TO MODULATE EXHAUST FAN SPEED TO ACHIEVE DUCT STATIC PRESSURE INITIALLY SET AT 0.30" W.G. (ADJ, FINAL SETPOINT BY TAB BASED ON SUB-BASEMENT LEVEL AFCV DAMPER POSITIONS WHILE AT MAX CFM SETPOINTS).

SAFETIES:

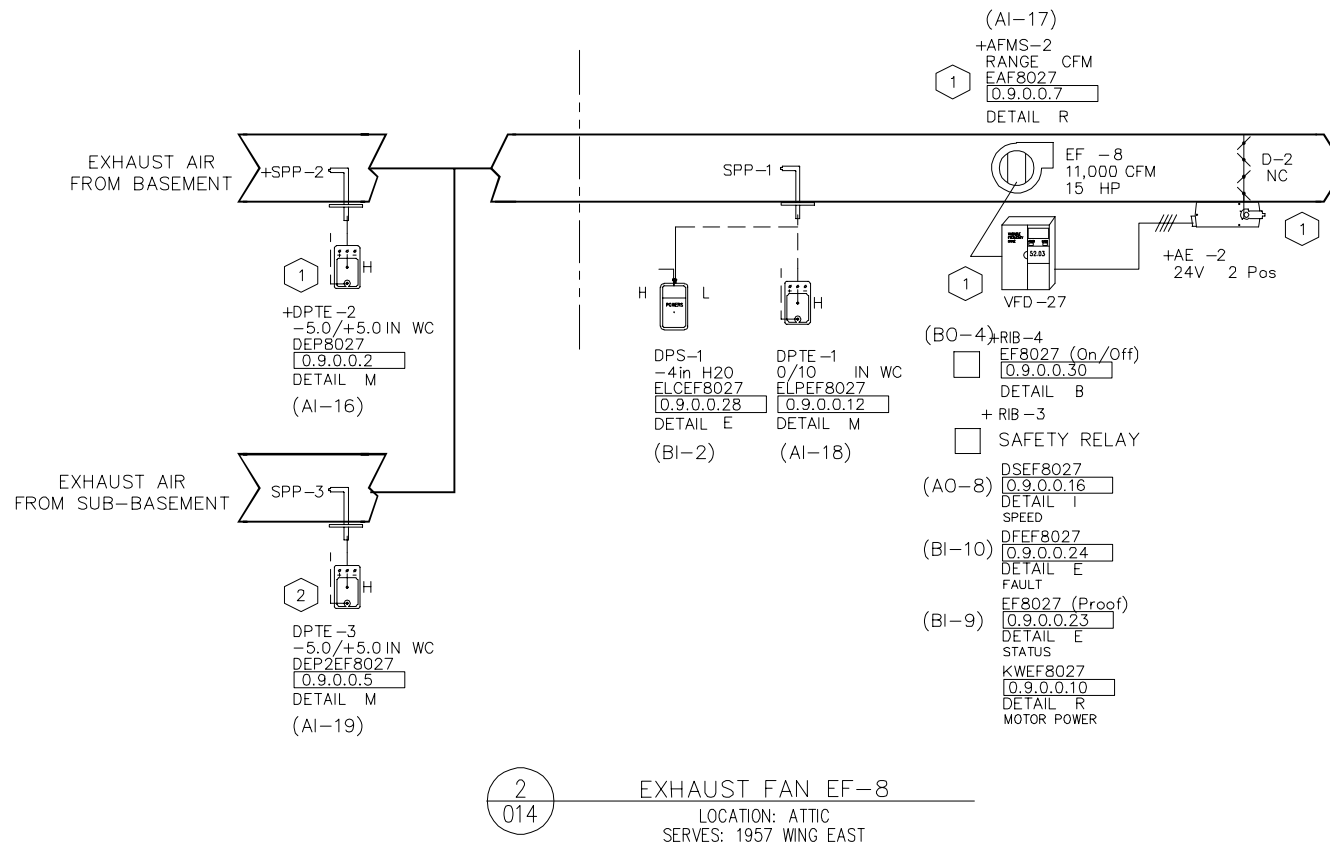
- NEW ANALOG SAFETY OVERRIDE TO LIMIT EXHAUST FAN PRESSURE AT INLET DUCT BOX STATIC SENSOR TO NOT EXCEED MINUS 3.8" W.G. (ADJ).
- NEW BINARY SAFETY LOW LIMIT SWITCH HARD WIRED TO FAN TO DISABLE FAN IF LOW LIMIT EXCEEDS MINUS 4.0" W.G. FURNISH A BINARY ALARM INPUT TO THE BAS.
- IN THE EVENT OF A FAN SHUTDOWN, THE TWO POSITION FAN DISCHARGE DAMPER CLOSES. FAN ISOLATION DAMPER SHALL CLOSE UPON LOSS OF POWER, BE CLOSED WHEN FAN IS OFF, AND CLOSE UPON LOSS OF ALL POWER. FAN DAMPER AND FAN MOTOR ARE WIRED TO GO OFF / CLOSE SIMULTANEOUSLY.

REVISION HISTORY		<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>		IU Research Labs Renovation IU PROJECT #20240397,					440P-388762	
				3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089					013	
				ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE		
				WLH	WLH		01/17/25	01/16/25		
				Swain Exhaust Fan 8						

INSTALLATION NOTES:

- EXISTING EQUIPMENT TO REMAIN.
- NEW DUCT STATIC SENSOR #2
LOCATED IN 22" X 16" DUCT OVER
S97 RESTROOM NEXT TO S21.

EXISTING EXHAUST FAN 8 IS BEING REPLACED WITH A NEW MOTOR
THE EXISTING SENSORS ARE TO REMAIN AND BE REUSED. A NEW
STATIC PRESSURE SENSOR (DPTE-3) IS BEING ADDED IN THE SUB-
BASEMENT ALONG WITH A NEW SUCTION PRESSURE CUTOUT (DPS-1)
AND SENSOR (DPTE-1) LOCATED AT EF-8 IN THE ATTIC.



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-6880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Swain Exhaust Fan 8

44OP-388762

014

BASE BID:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	2	GDE131.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5Nm
CBL 1	1	588-100B	SIEMENS	N/A	6-WIRE 2-RJ11 RS CABLE 50'PLMN
LCM 1	1	550-767FN	SIEMENS	149856	LCM-OAVS DAMPER SLOW SPEED
LGE 1	1	FBO	N/A	N/A	FURNISHED BY OTHERS
LGS 1	1	FBO	N/A	N/A	FURNISHED BY OTHERS
OAM 1-2	2	550-819B	SIEMENS	N/A	REMOTE AIR MODULE, PTEC
TTE 1	1	QAA2280.FWSC	SIEMENS	149820	RTS, TEC/RJ-11, FULL HMI
TTE 2	1	536-811	SIEMENS	149 134	DCT PT TMP, 100K OHM, 4", BRACKET MNT
V					SEE VALVE SUBMITTAL

ALTERNATE #1:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	4	GDE131.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5Nm
CBL 1	2	588-100B	SIEMENS	N/A	6-WIRE 2-RJ11 RS CABLE 50'PLMN
LCM 1	2	550-767FN	SIEMENS	149856	LCM-OAVS DAMPER SLOW SPEED
LGE 1	2	FBO	N/A	N/A	FURNISHED BY OTHERS
LGS 1	2	FBO	N/A	N/A	FURNISHED BY OTHERS
OAM 1-2	4	550-819B	SIEMENS	N/A	REMOTE AIR MODULE, PTEC
TTE 1	2	QAA2280.FWSC	SIEMENS	149820	RTS, TEC/RJ-11, FULL HMI
TTE 2	2	536-811	SIEMENS	149 134	DCT PT TMP, 100K OHM, 4", BRACKET MNT
V					SEE VALVE SUBMITTAL

STANDARD LABORATORY WITHOUT FUME HOOD CONTROL:

1. LAB SPACE TEMPERATURE IS MAINTAINED BY MODULATION OF THE SUPPLY AIR VOLUME AND REHEAT COIL VALVE. SUPPLY AIR VOLUME TO BE VARIED FROM 100% DOWN TO DESIGN MINIMUM BEFORE THE REHEAT VALVE IS MODULATED OPEN, UNLESS LAB AIR QUALITY DICTATES OTHERWISE. THE GENERAL EXHAUST VALVE IS MODULATED SUCH THAT THE AIR VOLUME LEAVING THE ROOM MAINTAINS THE PRESSURE DIFFERENTIAL NOTED ON PLANS. ROOM AIR CHANGE RATE SHALL NEVER FALL BELOW 4 AIR CHANGES PER HOUR (ADJ.) IN OCCUPIED MODE.

Room Ventilation Control

The Lab Room Controller (LRC) receives the value of the fume hood exhaust CFM set point in its area from the fume hood controller and measures the actual area general exhaust CFM. The LRC calculates total area exhaust CFM by adding the area general exhaust CFM and the total area fume hood exhaust set points together. The LRC modulates the area general exhaust to ensure that a minimum total area exhaust necessary to meet the required area ventilation rate is continuously maintained using a proportional, integral and derivative (PID) closed loop control algorithm.

Room Pressurization Control

The LRC uses airflow sensors in the AREA SUPPLY AIR to continuously measure the actual AREA SUPPLY AIR CFM. The LRC calculates the required AREA SUPPLY AIR CFM necessary to maintain the predetermined FLOW TRACKING DIFFERENTIAL by subtracting the flow tracking differential CFM set point (adjustable) from the total area exhaust CFM. The LRC modulates the AREA SUPPLY AIR CFM to ensure that the flow tracking differential CFM is always maintained by a proportional, integral and derivative (PID) closed loop control algorithm.

Room Temperature Control

The LRC measures the temperature in the area by means of the ROOM TEMPERATURE SENSOR and maintains the area temperature at the set point by modulating the NORMALLY CLOSED (N.C.) HEATING VALVE using a proportional, integral and derivative (PID) closed loop control algorithm.

Room supply air temperature is controlled within the adjustable maximum and minimum limits. If the AREA SUPPLY AIR is at its minimum temperature limit and the area requires increased cooling beyond the amount of AREA SUPPLY AIR CFM necessary to maintain the required FLOW TRACKING DIFFERENTIAL, the LRC increases the AREA SUPPLY AIR CFM as well as the AREA GENERAL EXHAUST CFM to maintain the room temperature set point and the FLOW TRACKING DIFFERENTIAL.

Control Priority

A priority structure applies to the above control applications to ensure that safety is maintained as the highest control priority when HVAC systems or individual components cannot meet all demands placed upon the system.

- 1. FUME HOOD CONTROL is the highest control priority.
- 2. ROOM PRESSURIZATION is second highest priority.
- 3. ROOM VENTILATION is the third level of priority.
- 4. ROOM TEMPERATURE CONTROL is the fourth level of priority.

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Swain LCM-OVAS Slow Act

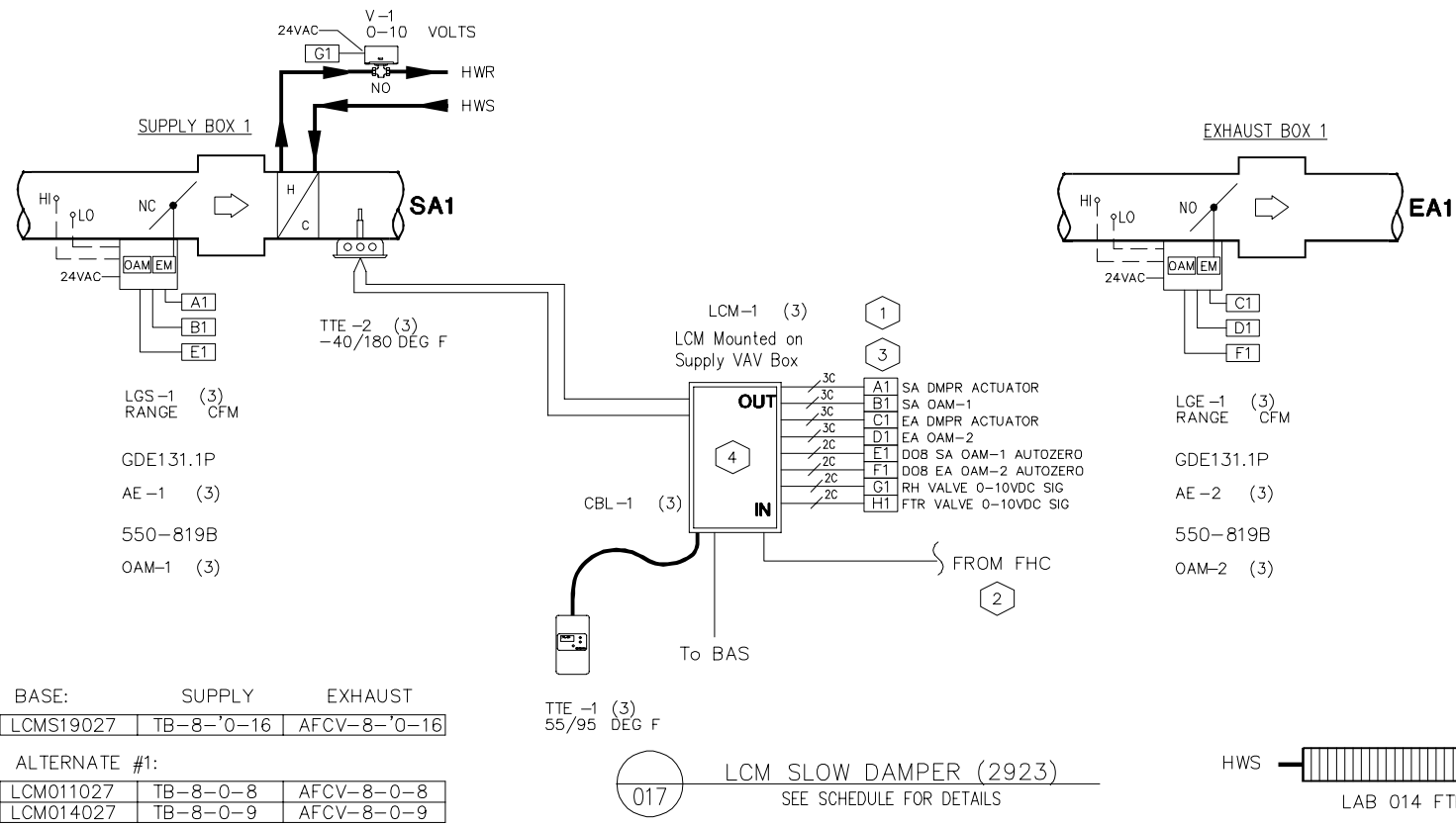
440P-388762

016

LCM-OAVS: Application (2923):
Room Pressurization with Slow-acting Damper
Actuation (One Exhaust,One Supply) and HW Reheat

INSTALLATION NOTES:

- 1 ALL WIRING TO MEET REQUIREMENTS OF STANDARD WIRING SPECIFICATIONS DRAWINGS
- 2 FLOW SIGNAL FROM (1) FHC OR FFM IF REQUIRED.
- 3 SEE THE ELECTRICAL DRAWING FOR DETAILS. CONFIRM ALL WIRING WITH INSTALLATION INSTRUCTIONS.
- 4 CONTROLLER TO BE FACTORY MOUNTED ON THE SUPPLY BOX.



BASE:	SUPPLY	EXHAUST
LCMS19027	TB-8-0-16	AFCV-8-0-16
ALTERNATE #1:		
LCM011027	TB-8-0-8	AFCV-8-0-8
LCM014027	TB-8-0-9	AFCV-8-0-9

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

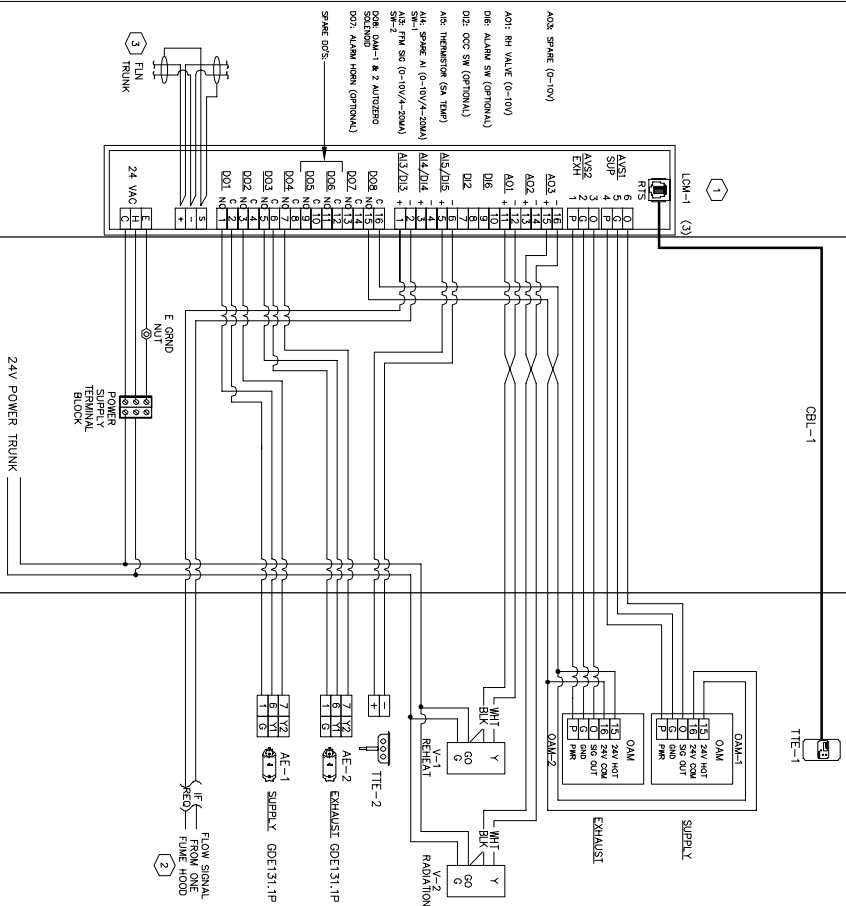
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/15/25

Swain LCM-OVAS Slow Act

440P-388762

017



INSTALLATION NOTES:

1. ALL WIRING TO MEET REQUIREMENTS OF STANDARD WIRING SPECIFICATIONS DRAWINGS
2. FLOW SIGNAL FROM (1) FHC OR FHC IF REQUIRED
3. 2-WIRE FLOW SIGNAL SHIELD CONNECT TO THE FHC FLOW TERMINATION AND THE SHIELD IS CARRIED THROUGHOUT.
4. A WIREMALL TO EARTH BOND MUST BE MADE AT THE SECONDARY SOURCE.

018 LAB RM CNTRL-WIRING (2923)
LOCATION:
COPYRIGHT 2013 SIMON INDUSTRIES INC.
6/23 17/05/2014

LCM Application (6723)
Supply Air & Exhaust Air Damper (3-Stage Actuation)
Standard Speed

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/16/25

Swain LCM-OVAS Slow Act

440P-388762

018

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1	1	GDE131.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5Nm
CBL 1	1	588-100B	SIEMENS	N/A	6-WIRE 2-RJ11 RS CABLE 50'PLMN
TEC 1	1	540-103N	SIEMENS	1491010	CONSTANT VOL CTLR ELEC OUT
TTE 1	1	QAA2280.EWSC	SIEMENS	149820	RTS, TEC/RJ-11, BLANK FRONT
TTE 2	1	536-811	SIEMENS	149 134	DCT PT TMP, 100K OHM, 4", BRACKET MNT
V					SEE VALVE SUBMITTAL

SEQUENCE OF OPERATION (CAV):

I. OCCUPIED MODE:

1. TERMINAL BOX CONTROLLER SHALL RESPOND TO CHANGES IN SPACE TEMPERATURE TO MODULATE REHEAT COIL VALVE. SUPPLY AIR VOLUME TO BE MAINTAINED AT A CONSTANT VALUE REGARDLESS OF CHANGES IN SUPPLY DUCT STATIC PRESSURE THROUGH CONTROL OF DAMPER ACTUATOR. HEATING COIL VALVE TO MAINTAIN MAXIMUM SUPPLY AIR TEMPERATURE OF 90 F (ADJ)
2. SPACE TEMPERATURE SET POINT IS 73 DEG F.(ADJ).

II. UNOCCUPIED MODE:

1. THE BUILDING CONTROL SYSTEM SHALL BE INDEXED FROM OCCUPIED TO UNOCCUPIED MODES BY A TIME PROGRAM IN THE CAMPUS BAS. INITIAL UNOCCUPIED CYCLE SHALL BE PROGRAMMED BY ECC FROM 11:00PM TO 7:00AM MONDAY THROUGH FRIDAY AND ALL WEEKENDS AND HOLIDAYS. COORDINATE HOURS WITH OWNER.
2. THE TERMINAL BOX MAINTAINS BETWEEN 68° AND 78° IN THE SPACE.

ANY AREA MAY BE RETURNED TO OCCUPIED MODE FOR TWO HOURS (ADJ) BY OPERATION OF THE MANUAL OVERRIDE SWITCH/PUSH BUTTON ON EACH AREA SENSOR. THIS SHALL INDEX THE AHU AS NOTED ON THE AHU CONTROL SCHEMATIC TO OCCUPIED

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/23/25

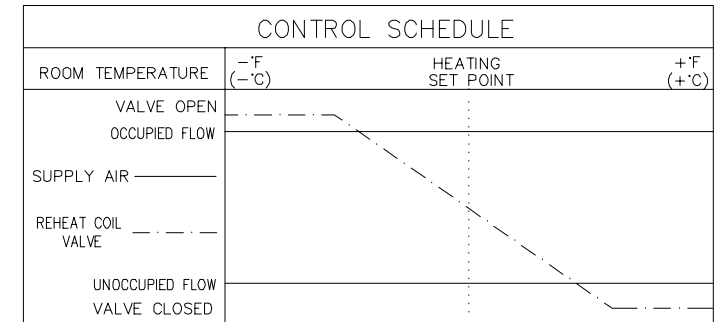
Swain CAV w/ HW Reheat

440P-388762

019

INSTALLATION NOTES:

- VAV BOX INSTALLED BY MECHANICAL CONTRACTOR WITH 3 TO 5 STRAIGHT DUCT DIAMETERS UPSTREAM OF BOX TO PROVIDE PROPER FLOW SENSING
- TEC-1 TO BE MOUNTED IN MANUFACTURER SUPPLIED CONTROLLER ENCLOSURE
- REFER TO BUILDING POWER TRUNK DRAWING FOR 24 VAC POWER
- MOUNT ACTUATOR WITH DAMPER IN FULL OPEN POSITION. VERIFY TEC-1 AND ACTUATOR REQUIREMENT WITH THE BOX MANUFACTURER
- LOCATE AS SHOWN ON FLOOR PLANS/CONTRACT DOCUMENTS

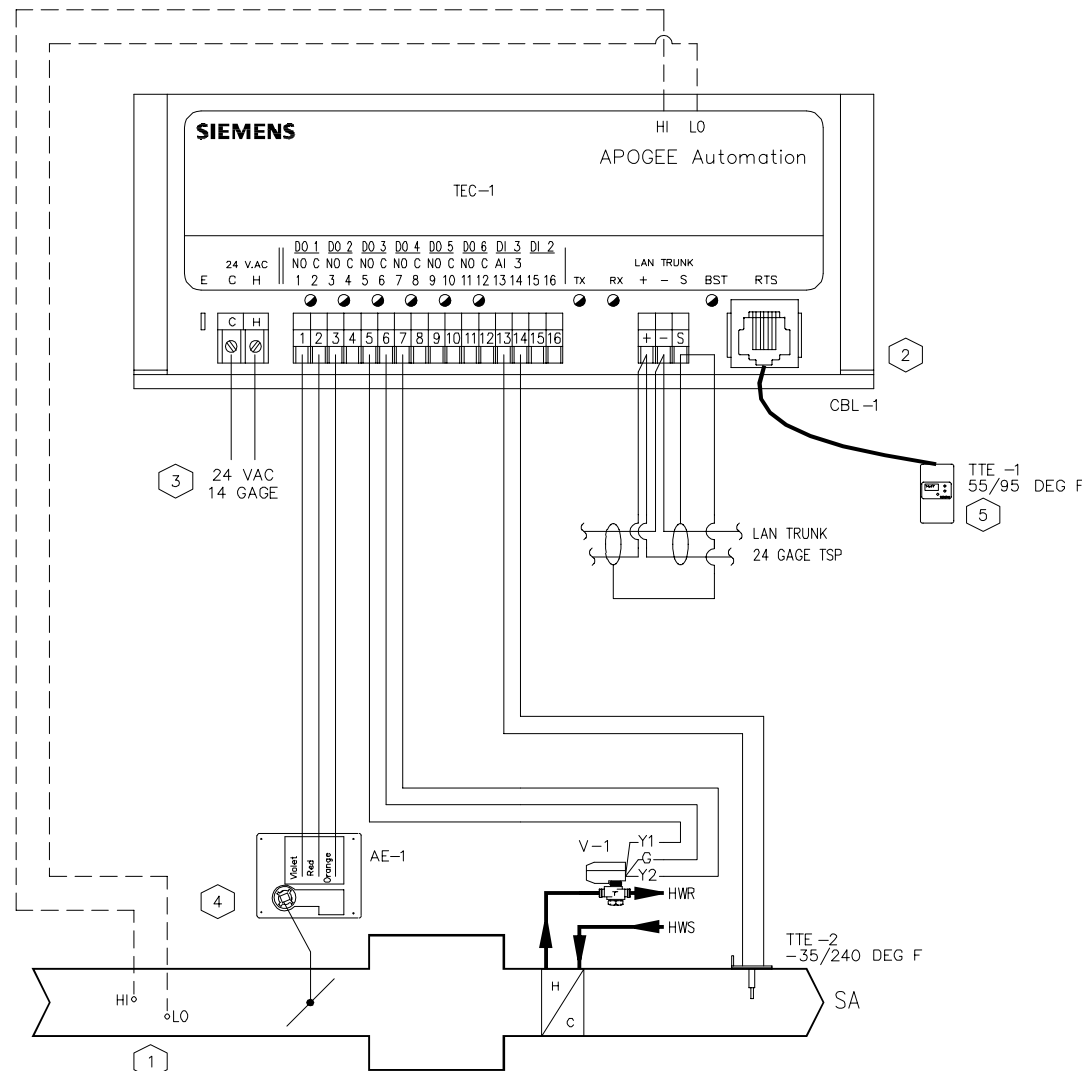


DEVICE	C.I.C.		MANUFACTURER	DIVISION 26	DIVISION 23
	FITTER	ELEC.			
TTE-1		M,W			
TTE-2		M,W			
AE-1		M,W			
TEC-1		M,W,P			
V-1		W			M
OCC SENSOR		W		M	
LAN TRUNK		W			
POWER (24VAC)		W			

M-MOUNTED
W-WIRED
P-PIPED

CAV WITH REHEAT COIL (#2033)
TYPICAL OF 1
CAVS20027: TB-8-'0-5

020



BASE:

CAVS20027 TB-8-'0-5

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/16/25

Swain CAV w/ HW Reheat

440P-388762

020

BASE BID:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE1	1	GDE131.1U	SIEMENS	154 011	ACT NSR 24/108L 5NM,NO PLENUM
TEC1	1	540-104N	SIEMENS	N/A	CNST VOL CTLR W/AUTOZERO ELEC

ALTERNATE #1:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE1	1	GDE131.1U	SIEMENS	154 011	ACT NSR 24/108L 5NM,NO PLENUM
TEC1	1	540-104N	SIEMENS	N/A	CNST VOL CTLR W/AUTOZERO ELEC

SEQUENCE OF OPERATION – STANDALONE AIRFLOW CONTROL VALVE EXHAUST:

- I. OCCUPIED MODE:

1. PRESSURE-INDEPENDENT AIRFLOW CONTROL VALVE (AFCV) SHALL BE CONTROLLED AT A CONSTANT VALUE REGARDLESS OF CHANGES IN SUPPLY DUCT STATIC PRESSURE THROUGH CONTROL OF DAMPER ACTUATOR. THROUGH LAN TO OPERATORS WORK STATION IT SHALL BE POSSIBLE TO READ AND ADJUST EXHAUST AIR VOLUMES (MAXIMUM AND MINIMUMS).
- II. UNOCCUPIED MODE:

1. THERE IS NO UNOCCUPIED MODE.

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

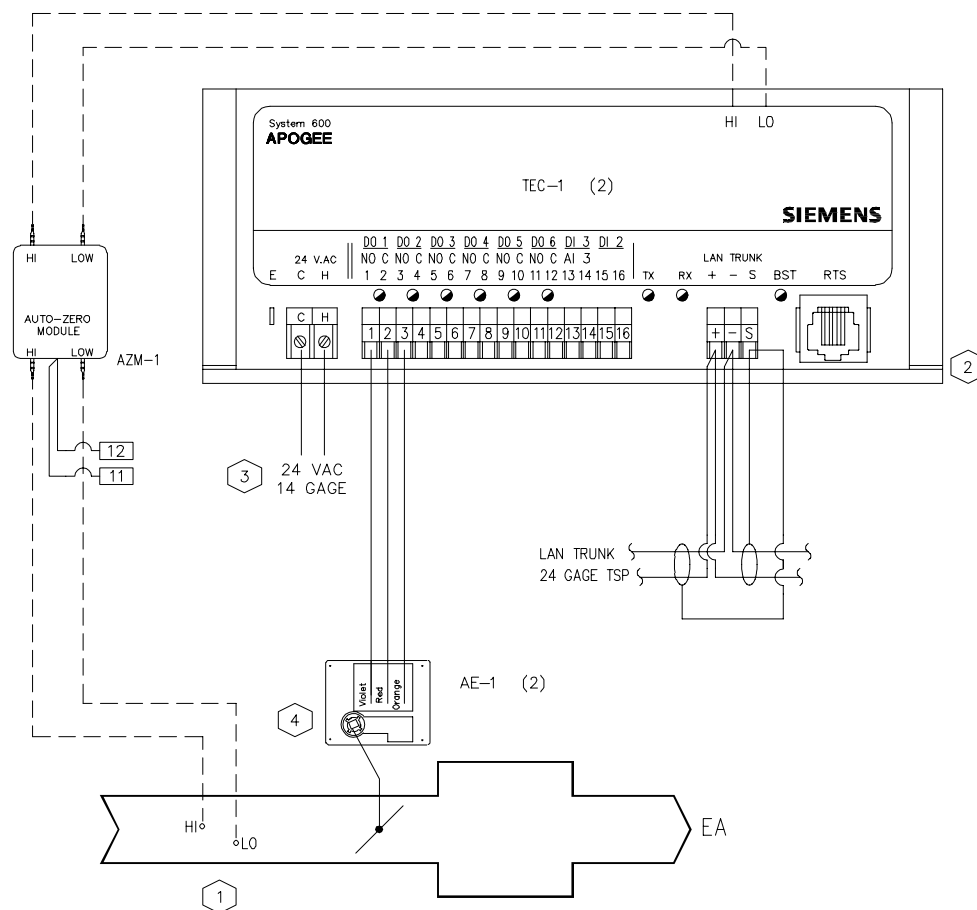
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Swain CAV Exhaust Valve (2030)

440P-388762

021



INSTALLATION NOTES:

- CV BOX INSTALLED BY MECHANICAL CONTRACTOR WITH 3 TO 5 STRAIGHT DUCT DIAMETERS UPSTREAM OF BOX TO PROVIDE PROPER FLOW SENSING.
- CONTROLLER TO BE FACTORY MOUNTED ON THE EXHAUST VALVE.
- REFER TO BUILDING POWER TRUNK DRAWING FOR 24 VAC POWER
- MOUNT ACTUATOR IN FULL CLOCKWISE POSITION WITH DAMPER FULL OPEN POSITION. VERIFY TEC-1 AND ACTUATOR REQUIREMENT WITH THE BOX MANUFACTURER

CONTROL SCHEDULE		
ROOM TEMPERATURE	'F (-°C)	'F (+°C)
FULL OPEN		
OCCUPIED FLOW		
EXHAUST AIR		
UNOCCUPIED FLOW		
CLOSED		

DEVICE	SIEMENS		MANUFACTURER	DIVISION 16	DIVISION 15
	FITTER	ELEC.			
AE-1		M,W			
TEC-1		M,W,P			
LAN TRUNK		W			
POWER (24VAC)		W			

M-MOUNTED
W-WIRED
P-PIPED

022 CONSTANT VOLUME BOX (#2030)
TYPICAL OF 2
CAVS96027: AFCV-8-0-08
CAV011027: AFCV-8-0-1 (ALT #1)

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	MED	01/17/25	01/15/25

Swain CAV Exhaust Valve (2030)

440P-388762

022

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AUX 1-2	2	567-352	SIEMENS	155 272	#3 PNEU PANEL 24X24X9
PNL 1	1	PXA-ENC34	SIEMENS	149475	ENCLOSURE ASSY 34
	1	PXA-SB115V192VA	SIEMENS	588783	SERVICE BOX 115V, 24VAC, 192VA
PNL 2	1	PXA-ENC34	SIEMENS	149475	ENCLOSURE ASSY 34
	1	PXA-SB115V192VA	SIEMENS	588783	SERVICE BOX 115V, 24VAC, 192VA
PWR 1-9	9	PSH500A	FUNCTIONAL DEVICES	1208cut143	PS FIVE 100VA C2 120-24VAC ENC
PWR 10	1	PSH500A	FUNCTIONAL DEVICES	1208cut143	PS FIVE 100VA C2 120-24VAC ENC
Panel Mounted Devices					
SW 1	1	C1000-16T-2G-L	CISCO	N/A	CATALYST 1000 16 PORT SWITCH
SW 2	1	C1000-16T-2G-L	CISCO	N/A	CATALYST 1000 16 PORT SWITCH

REVISION HISTORY	<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>	<div>3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089</div>	IU Research Labs Renovation					440P-388762
			IU PROJECT #20240397,					
			ENGINEER WLH	DRAFTER WLH	CHECKED BY	INITIAL RELEASE 01/17/25	LAST EDIT DATE 01/16/25	023
			Chemistry Riser					

INSTALLATION NOTES:

1

REFER TO PLANS FOR MORE DETAIL ON CONTROL PANEL LOCATIONS.

2

POWER TO IDC PANELS BY DIVISION 26 ELECTRICAL AS STATED IN CONTRACT DOCUMENTS. POWER THAT IS NOT INDICATED IN CONTRACT DOCUMENTS BUT IS REQUIRED FOR BUILDING AUTOMATION SYSTEM (BAS) SHALL BE THE RESPONSIBILITY OF THE CONTROLS INSTALLATION CONTRACTOR (CIC).

3

CIC TO PROVIDE BARRIER FOR SEPARATION WITHIN THE ELECTRIC TROUGH OF LOW VOLTAGE WIRE AND 120V POWER WIRING.

4

REFER TO TX-I/O WIRING SPECIFICATION DRAWING TWR FOR PXC1 COMMUNICATION TERMINATION DETAILS.

5

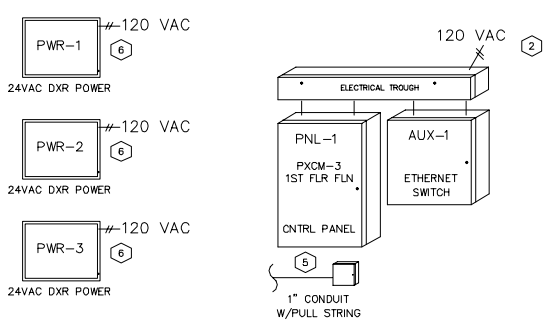
CIC TO PROVIDE A DEDICATED 1" CONDUIT WITH A PULL STRING FROM IDF/MDF ROOM TO A JUNCTION BOX (MINIMUM 6"x6"x4") LOCATED NEXT TO SIEMENS PANEL WITH A RACEWAY FOR PATCH CABLE CONNECTION TO PXC1 CONTROLLER. COORDINATE WITH IU FOR LOCATION OF IDF/MDF ROOM. IF 2-4 ETHERNET CABLES ARE NEEDED A 1 1/4" CONDUIT IS REQUIRED.

6

TRANSFORMER PANELS TO BE LOCATED IAS SHOWN. REFER TO ELECTRICAL DRAWINGS FOR EXACT LOCATION. MOUNTING AND FIELD WIRING BY CIC, POWER WIRING BY EC.

1ST FLR

ELECTRICAL RM A139

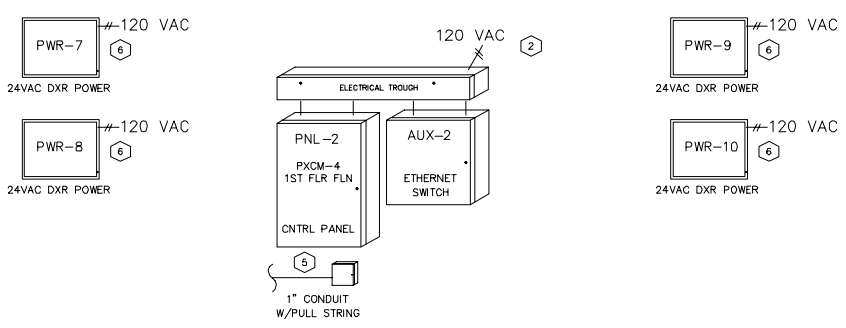


(2) ETHERNET DATA DROPS REQUIRED
PXC1-3 AND THE ETHERNET SWITCH

1
024

PXC1-3 PHASE 1 (SOUTH)
LABS A122, A132, A140, A142
A148, A150, A162

ELECTRICAL RM A105



(2) ETHERNET DATA DROPS REQUIRED
PXC1-4 AND THE ETHERNET SWITCH

2
024

PXC1-4 PHASE 2 (NORTH)
LABS 102, 103, 104, 105
A151, A153, A251, A252

GROUND

REVISION HISTORY	<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>		<div>3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089</div>				<div>IU Chemistry Gnd-1st Fir Labs IU PROJECT #20231351,</div> <div>ENGINEER WLH</div> <div>DRAFTER WLH</div> <div>CHECKED BY</div> <div>INITIAL RELEASE 11/01/24</div> <div>LAST EDIT DATE 01/14/25</div> <div>Chemistry Riser</div>		<div>440P-387655</div> <div>024</div>

INSTALLATION NOTES:

- 1 SIEMENS FLOOR LEVEL NETWORK CABLE TO BE CONNECTED TO AN ETHERNET SWITCH (SW-1) LOCATED IN THE AUX PANEL FOR PXCM-1 IN THE 1ST FLOOR SERVICE CORRIDOR.
- 2 POWER TRUNK XFMR TO BE LOCATED PER CONTRACT DOCUMENTS. 120V POWER PROVIDED BY E.C. MOUNTING AND FIELD WIRING BY C.I.C.

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
1	LTB	-	A140-1	1ST	???	M213	A140	LAB SPACE	1 CKT 1
1	LTB	-	A140-2	1ST	???	M213	A140	LAB SPACE	1 CKT 2
1	LTB	-	A140-3	1ST	???	M213	A140	LAB SPACE	1 CKT 3
1	LTB	-	A140-4	1ST	???	M213	A140	LAB SPACE	1 CKT 4
1	LTB	-	A140-5	1ST	???	M213	A140	LAB SPACE	1 CKT 5
1	FHEV	-	A140-1A	1ST	???	M213	A140	LAB SPACE	2 CKT 1
1	FHEV	-	A140-1B	1ST	???	M213	A140	LAB SPACE	2 CKT 1
1	FHEV	-	A140-2A	1ST	???	M213	A140	LAB SPACE	2 CKT 2
1	FHEV	-	A140-2B	1ST	???	M213	A140	LAB SPACE	2 CKT 2
1	FHEV	-	A140-3A	1ST	???	M213	A140	LAB SPACE	2 CKT 3
1	FHEV	-	A140-3B	1ST	???	M213	A140	LAB SPACE	2 CKT 3
1	FHEV	-	A140-4A	1ST	???	M213	A140	LAB SPACE	2 CKT 4
1	FHEV	-	A140-4B	1ST	???	M213	A140	LAB SPACE	2 CKT 4
1	FHEV	-	A140-5A	1ST	???	M213	A140	LAB SPACE	2 CKT 5
1	FHEV	-	A140-5B	1ST	???	M213	A140	LAB SPACE	2 CKT 5

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
2	LTB	-	A140-6	1ST	???	M213	A140	LAB SPACE	3 CKT 1
2	LTB	-	A140-7	1ST	???	M213	A140	LAB SPACE	3 CKT 2
2	LTB	-	A140-8	1ST	???	M213	A140	LAB SPACE	3 CKT 3
2	LTB	-	A140-9	1ST	???	M213	A140	LAB SPACE	3 CKT 4
2	LTB	-	A140-10	1ST	???	M213	A140	LAB SPACE	3 CKT 5
2	FHEV	-	A140-7A	1ST	???	M213	A140	LAB SPACE	4 CKT 1
2	FHEV	-	A140-7B	1ST	???	M213	A140	LAB SPACE	4 CKT 1
2	FHEV	-	A140-8A	1ST	???	M213	A140	LAB SPACE	4 CKT 2
2	FHEV	-	A140-8B	1ST	???	M213	A140	LAB SPACE	4 CKT 2
2	FHEV	-	A140-9A	1ST	???	M213	A140	LAB SPACE	4 CKT 3
2	FHEV	-	A140-9B	1ST	???	M213	A140	LAB SPACE	4 CKT 3
2	FHEV	-	A140-10A	1ST	???	M213	A140	LAB SPACE	4 CKT 4
2	FHEV	-	A140-10B	1ST	???	M213	A140	LAB SPACE	4 CKT 4
2	FTR	-	A140	1ST	N/A	M213	A140	LAB SPACE	4 CKT 5

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
3	TB	-	A122	1ST	???	M213	A122	GRAD OFFICE	5 CKT 1
3	TB	-	A132	1ST	???	M213	A132	GRAD OFFICE	5 CKT 1
3	TB	-	A140A	1ST	???	M213	A140A	LAB SUPPORT	5 CKT 2
3	TB	-	A140B	1ST	???	M213	A140B	LAB SUPPORT	5 CKT 2
3	TB	-	A140C	1ST	???	M213	A140C	LAB SUPPORT	5 CKT 3
3	TB	-	A142	1ST	???	M213	A142	GRAD OFFICE	5 CKT 3
3	TB	-	A148	1ST	???	M213	A148	SPECIALITY SUPPORT	5 CKT 4
3	TB	-	A150	1ST	???	M213	A150	CONFERENCE ROOM	5 CKT 4
3	TB	-	A150A	1ST	???	M213	A150A	OFFICE	5 CKT 5
3	TB	-	A150B	1ST	???	M213	A150B	OFFICE	5 CKT 5
3	TB	-	A150C	1ST	???	M213	A150C	OFFICE	5 CKT 5

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
4	TB	-	A162	1ST	???	M212	A162	CONFERENCE ROOM	6 CKT 1
4	TB	-	A162A	1ST	???	M212	A162A	OFFICE	6 CKT 1
4	TB	-	A162B	1ST	???	M212	A162B	GRAD OFFICE	6 CKT 1

SW -1

1ST FLR SOUTH

AUX-1

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

PXCM-3 South Riser

440P-388762

025

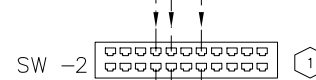
INSTALLATION NOTES:

- SIEMENS FLOOR LEVEL NETWORK CABLE TO BE CONNECTED TO AN ETHERNET SWITCH (SW-1) LOCATED IN THE AUX PANEL FOR PXCM-1 IN THE 1ST FLOOR SERVICE COORIDOR.
- POWER TRUNK XFMR TO BE LOCATED PER CONTRACT DOCUMENTS. 120V POWER PROVIDED BY E.C. MOUNTING AND FIELD WIRING BY C.I.C.

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
1	LTB	-	103	1ST	???	M210	103	LAB SPACE	7 CKT 1
1	FHEV	-	103-A	1ST	???	M210	103	LAB SPACE	7 CKT 2
1	FHEV	-	103-B	1ST	???	M210	103	LAB SPACE	7 CKT 2
1	LTB	-	103A	1ST	???	M210	103A	BSL2 ROOM	7 CKT 3
1	FHEV	-	103A-A	1ST	???	M210	103A	BSL2 ROOM	7 CKT 4
1	FHEV	-	103A-B	1ST	???	M210	103A	BSL2 ROOM	7 CKT 4
1	TB	-	103B	1ST	???	M210	103B	LAB SPACE	7 CKT 5
1	TB	-	103C	1ST	???	M210	103C	GRAD STUDENT OFFICE	7 CKT 5
1	TB	-	103D	1ST	???	M210	103D	GRAD STUDENT OFFICE	8 CKT 1
1	TB	-	105	1ST	???	M210	105	OFFICE	8 CKT 1
1	TB	-	105A	1ST	???	M210	105A	OFFICE	8 CKT 1

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
2	TB	-	102-1	1ST	???	M211	102	LAB SPACE	8 CKT 2
2	TB	-	102-2	1ST	???	M211	102	LAB SPACE	8 CKT 2
2	TB	-	102A	1ST	???	M211	102A	LAB SUPPORT	8 CKT 3
2	LTB	-	104	1ST	???	M211	104	LAB SPACE	9 CKT 1
2	FHEV	-	104-A	1ST	???	M211	104	LAB SPACE	9 CKT 2
2	FHEV	-	104-B	1ST	???	M211	104	LAB SPACE	9 CKT 2
2	FHEV	-	104-C	1ST	???	M211	104	LAB SPACE	9 CKT 3
2	TB	-	A151	1ST	???	M211	A151	FREEZER/FRIDGE ROOM	8 CKT 3
2	TB	-	A153	1ST	???	M211	A153	ELECTRONICS ROOM	8 CKT 4
2	EVV		A153	1ST	???	M211	A153	ELECTRONICS ROOM	8 CKT 4
2	TB	-	A151A	1ST	???	M211	A151A	BRUKER HCT ROOM	8 CKT 5
2	EVV		A151A	1ST	???	M211	A151A	BRUKER HCT ROOM	8 CKT 5

LOOP	UNIT TYPE		UNIT NUM	LEVEL	AHU	PRINT	ROOM NUM	ROOM DESC	POWER SUPPLY
3	TB	-	A251	2ND	???	M220	A251	GRAD OFFICE	10 CKT 5
3	LTB	-	A252-1	2ND	???	M220	A252	LAB SPACE	10 CKT 1
3	LTB	-	A252-2	2ND	???	M220	A252	LAB SPACE	10 CKT 2
3	FHEV	-	A252-1A	2ND	???	M220	A252	LAB SPACE	10 CKT 3
3	FHEV	-	A252-1B	2ND	???	M220	A252	LAB SPACE	10 CKT 3
3	FHEV	-	A252-2A	2ND	???	M220	A252	LAB SPACE	10 CKT 4
3	FHEV	-	A252-2B	2ND	???	M220	A252	LAB SPACE	10 CKT 4



1ST FLR NORTH

AUX-2

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

PXCM-4 North Riser

440P-388762

026

BASE BID:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE1	10	GAP191.1P	SIEMENS	154-083	FAIL IN PLACE, 50 LB-IN, 2 SEC.
DPTE1	10	DXA.S04P1	SIEMENS	N/A	AIR FLOW PRES SENSOR 1"
DXR1	10	DXR2.E17C-103B	SIEMENS	N/A	DXR2.E17C-103B AUTOMATION STATION
TTE1	10	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE2	10	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

ALTERNATE #4:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE1	1	GAP191.1P	SIEMENS	154-083	FAIL IN PLACE, 50 LB-IN, 2 SEC.
DPTE1	1	DXA.S04P1	SIEMENS	N/A	AIR FLOW PRES SENSOR 1"
DXR1	1	DXR2.E17C-103B	SIEMENS	N/A	DXR2.E17C-103B AUTOMATION STATION
TTE1	1	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE2	1	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

SEQUENCE OF OPERATION

1. LABORATORY HOOD FACE VELOCITY IS TO BE MAINTAINED AT A CONSTANT 80 FPM AS THE VERTICAL SASH (AND COMBINATION HORIZONTAL SASHES AS APPLICABLE) MOVES THROUGH USE OF SASH POSITION SENSING. VOLUME CONTROLLER MODULATES FHEV IN EXHAUST DUCT TO MAINTAIN CONSTANT FACE VELOCITY. FUME HOOD EXHAUST SHALL VARY TO MAINTAIN FACE VELOCITY WHILE NOT VARYING BELOW THE MINIMUM AIRFLOW VALUE (200 CFM FOR A SIX FOOT WIDE FUME HOOD; 175 CFM FOR A FIVE FOOT WIDE FUME HOOD; 150 CFM FOR A FOUR FOOT WIDE FUME HOOD; 125 CFM FOR A THREE FOOT WIDE FUME HOOD; 100 CFM FOR A TWO FOOT WIDE FUME HOOD). THE MAXIMUM AIRFLOW AT 80 FPM AT 18" SASH HEIGHT (675 CFM IN A SIX FOOT HOOD; 550 CFM IN A FIVE FOOT HOOD; 425 CFM IN A FOUR FOOT HOOD) SHALL NOT BE EXCEEDED WHEN THE SASH IS RAISED ABOVE 18" (FACE VELOCITY WILL DROP BELOW SETPOINT AS SASH IS RAISED ABOVE 18" AND ALARM WHEN LOW FACE VELOCITY LIMIT IS REACHED).
2. SPACE TEMPERATURE TO BE MAINTAINED AT AN OCCUPIED CONTROL SETPOINT THROUGH MODULATION OF THE LAB GENERAL EXHAUST VALVE WHICH ACHIEVING THE SCHEDULED AIRFLOW OFFSET. SUPPLY AIRFLOW TRACKS EXHAUST AIRFLOW.
3. THE TOTAL SUPPLY AIR VOLUME IS TO BE COMPARED TO THE TOTAL LABORATORY EXHAUST AIR VOLUME AND THE SUPPLY MODULATED SUCH THAT THE TOTAL EXHAUST EXCEEDS THE SUPPLY AIR VOLUME BY THE REQUIRED SCHEDULED OFFSET (SUPPLY TRACKS EXHAUST). TOTAL LABORATORY EXHAUST AIR VOLUME IS THE SUM OF THE GENERAL EXHAUST AIRFLOW VALUE, THE MULTIPLE FUME HOOD EXHAUST FLOW VALUES (WHERE APPLICABLE), AND THE EQUIPMENT EXHAUST FLOW VALUES (WHERE APPLICABLE). TOTAL LABORATORY SUPPLY AIR VOLUME SHALL NOT DROP BELOW THE SCHEDULED MINIMUM OCCUPIED AND UNOCCUPIED AIRFLOWS. AIRFLOWS SHALL BE MEASURED IN REAL TIME.
4. THE LAB SPACE TEMPERATURE SETPOINT IS MAINTAINED BY MODULATING OF THE HEATING VALVE(S). IN THE EVENT THAT THE SUPPLY AIRFLOW SIGNAL IS OUT OF RANGE (AS IN THE CASE OF REDUCED AIR HANDLING SUPPLY CAPACITY), THE LAB GENERAL EXHAUST VALVE SHALL BE COMMANDED FULLY CLOSED AND THE SPACE TEMPERATURE ALLOWED TO RISE ABOVE SETPOINT (TO REDUCE THE EXCESS NEGATIVE PRESSURE POTENTIAL IN THE BUILDING)
5. LARGE LAB SPACES CONSISTING OF MULTIPLE LAB CONTROL SYSTEM MODULES WHERE THERE ARE MULTIPLE SPACE SENSORS INSTALLED WITHIN THE BOUNDING WALLS OF THE SPACE SHALL HAVE PROVISIONS PROGRAMMED TO WEIGHT INDIVIDUAL SENSORS (DEFAULT EQUAL WEIGHTING) AND TO UTILIZE THE LOW, HIGH OR AVERAGE SENSOR AS THE SPACE SENSOR INPUT FOR ALL LAB SYSTEM MODULES IN THE MULTIPLE LAB SYSTEM MODULE SPACE. THE CONTROLLER SHALL PROHIBIT DIFFERING SPACE SENSOR SETTINGS WHICH WOULD LEAD TO HEATING ONE PORTION OF THE LARGE LAB SPACE WHILE ANOTHER PORTION IS CALLING FOR COOLING.
6. PROVIDE DISCREET OUTPUTS FOR EACH AIR VALVE (LTB OR LGEV) IN A GIVEN LAB CONTROLLER SO THAT EACH AIR VALVE OUTPUT CAN BE SCALED TO MATCH ACTUAL DELIVERED AIRFLOW AS DETERMINED THROUGH THE TAB PROCESS.
7. PROVIDE ALL HARDWARE AND SOFTWARE FOR ALL SIGNALS TO BE COMPLETELY CONTAINED WITHIN THE INDIVIDUAL LABORATORY. NO NECESSARY SIGNALS SHALL PASS IN NOR OUT OF THE PHYSICAL LIMITS OF THE LAB EXCEPT FOR TIME/DATE INFORMATION AND THE DEMAND INDICATORS.
8. TIME SCHEDULE AND OCCUPANCY SENSORS ARE UTILIZED TO RESET SPACE MINIMUM AIRCHANGE RATES (NO RESET / SETBACK OF THE LAB SPACE TEMPERATURES). SCHEDULED SPACE OCCUPIED MODE FOR THE LABS SHALL BE: OCCUPIED DAYTIME FROM - 7:00 A.M. TO 6:00 P.M., 365 DAYS PER YEAR. SCHEDULED SPACE UNOCCUPIED MODE IS AT ALL OTHER TIMES. SENSING OF OCCUPANCY DURING UNOCCUPIED MODE RETURNS THE SPACE TO OCCUPIED SPACE TEMPERATURE SETPOINTS. SENSING OF NO OCCUPANCY DURING THE SCHEDULED OCCUPIED MODE DOES NOT REVISE THE AIRFLOW SETPOINTS TO THE UNOCCUPIED SETTINGS.

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

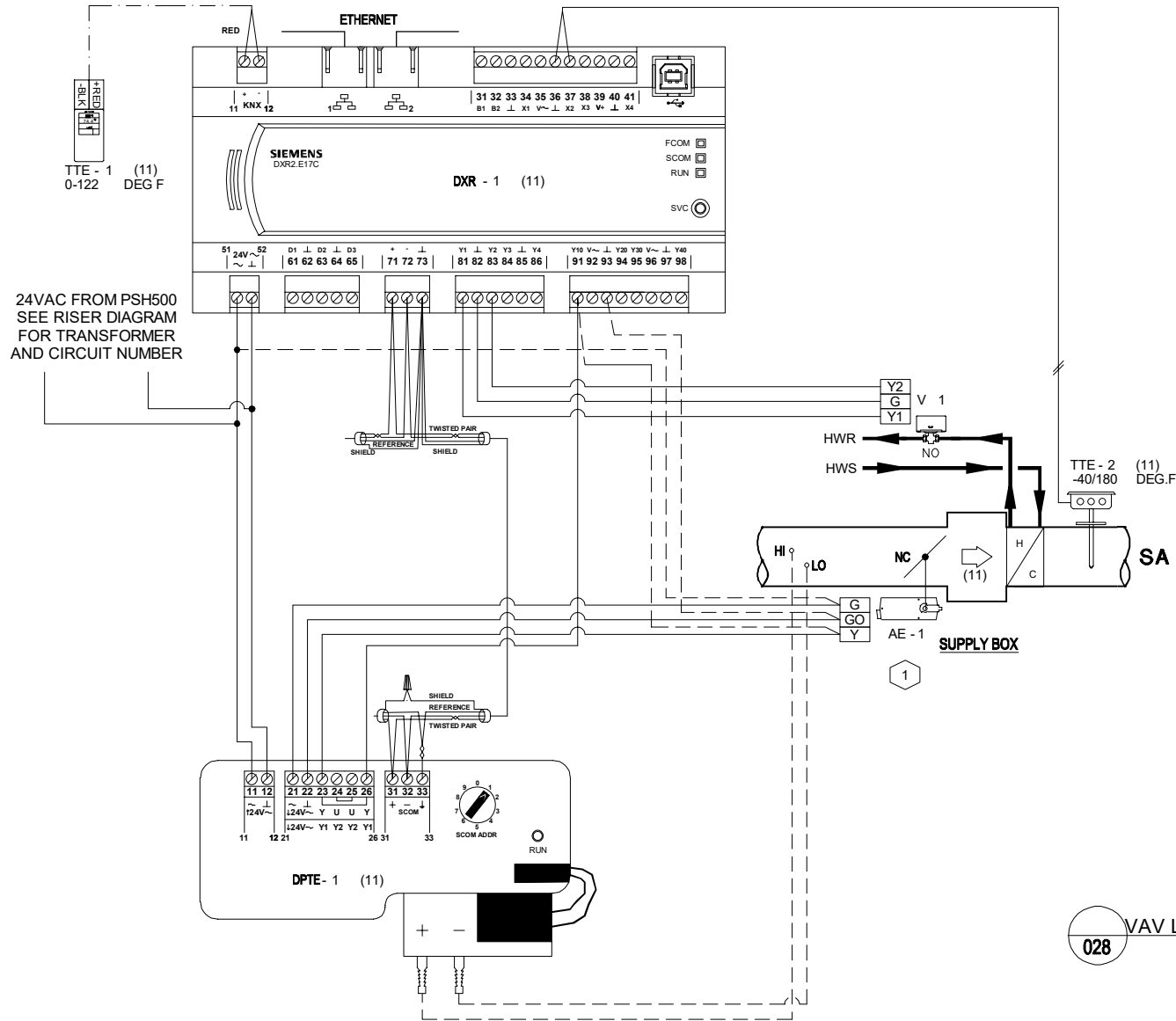
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Chemistry LRC - LTB Fast Act

440P-388762

027



INSTALLATION NOTES:

- 1 DAMPER ACTUATOR MAY BE WIRED EITHER DIRECTLY FROM THE DXR OR FROM THE DXR TO THE APS (DPTE) THEN TO THE DAMPER ACTUATOR.

DATA POINTS (30 MAX)	
PHYSICAL	4
KNX	3
TOTAL	7

KNX LOADS (50mA MAX)	
TTE-1	10mA
TOTAL	10mA

24 VAC LOADS	
DXR-1	8VA
OCCB-1	X
V-1	X
TOTAL	8VA

028 VAV LRC - FAST ACT DAMPER HW Rht
TYPICAL OF (10 BASE 1 ALT)
LTB'S A140-1, A140-2, A140-3, A140-4
A140-5, A140-7, A140-8, A140-9, A140-10
104 & A252-2(ALT #4)

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Chemistry Gnd-1st Flr Labs
IU PROJECT #20231351,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		11/01/24	01/14/25

Chemistry LRC - LTB Fast Act

440P-387655

028

BASE BID:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	6	GAP191.1P	SIEMENS	154-083	FAIL IN PLACE, 50 LB-IN, 2 SEC.
DPTE 1-2	6	DXA.S04P1	SIEMENS	N/A	AIR FLOW PRES SENSOR 1"
DXR 1	3	DXR2.E17C-103B	SIEMENS	N/A	DXR2.E17C-103B AUTOMATION STATION
OCC 1	3	FBO	N/A	N/A	FURNISHED BY OTHERS
TTE 1	3	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE 2	3	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

ALTERNATE #4:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	2	GAP191.1P	SIEMENS	154-083	FAIL IN PLACE, 50 LB-IN, 2 SEC.
DPTE 1-2	2	DXA.S04P1	SIEMENS	N/A	AIR FLOW PRES SENSOR 1"
DXR 1	1	DXR2.E17C-103B	SIEMENS	N/A	DXR2.E17C-103B AUTOMATION STATION
OCC 1	1	FBO	N/A	N/A	FURNISHED BY OTHERS
TTE 1	1	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE 2	1	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

1. LABORATORY HOOD FACE VELOCITY IS TO BE MAINTAINED AT A CONSTANT 80 FPM AS THE VERTICAL SASH (AND COMBINATION HORIZONTAL SASHES AS APPLICABLE) MOVES THROUGH USE OF SASH POSITION SENSING. VOLUME CONTROLLER MODULATES FHEV IN EXHAUST DUCT TO MAINTAIN CONSTANT FACE VELOCITY. FUME HOOD EXHAUST SHALL VARY TO MAINTAIN FACE VELOCITY WHILE NOT VARYING BELOW THE MINIMUM AIRFLOW VALUE (200 CFM FOR A SIX FOOT WIDE FUME HOOD; 175 CFM FOR A FIVE FOOT WIDE FUME HOOD; 150 CFM FOR A FOUR FOOT WIDE FUME HOOD; 125 CFM FOR A THREE FOOT WIDE FUME HOOD; 100 CFM FOR A TWO FOOT WIDE FUME HOOD). THE MAXIMUM AIRFLOW AT 80 FPM AT 18" SASH HEIGHT (675 CFM IN A SIX FOOT HOOD; 550 CFM IN A FIVE FOOT HOOD; 425 CFM IN A FOUR FOOT HOOD) SHALL NOT BE EXCEEDED WHEN THE SASH IS RAISED ABOVE 18" (FACE VELOCITY WILL DROP BELOW SETPOINT AS SASH IS RAISED ABOVE 18" AND ALARM WHEN LOW FACE VELOCITY LIMIT IS REACHED).
2. SPACE TEMPERATURE TO BE MAINTAINED AT AN OCCUPIED CONTROL SETPOINT THROUGH MODULATION OF THE LAB GENERAL EXHAUST VALVE WHICH ACHIEVING THE SCHEDULED AIRFLOW OFFSET. SUPPLY AIRFLOW TRACKS EXHAUST AIRFLOW.
- A. MODULATE LAB GENERAL EXHAUST VALVE FROM THE MINIMUM AIRFLOW TO THE MAXIMUM (SUM OF THE CONNECTED GRILLES AND DIFFUSERS) TO MAINTAIN SPACE TEMPERATURE COOLING. THE MINIMUM LGEV AIRFLOWS SHALL BE 25 CFM FOR A SIZE 6", 40 CFM FOR A SIZE 7", 60 CFM FOR A SIZE 8", 80 CFM FOR A SIZE 9", 100 CFM FOR A SIZE 10", 120 CFM FOR A SIZE 12", 200 CFM FOR A SIZE 14", AND 400 CFM FOR A SIZE 16".
- B. WHEN SPACE HEATING IS REQUIRED, THE HEATING COIL HYDRONIC VALVE IS MODULATED OPEN.
3. THE TOTAL SUPPLY AIR VOLUME IS TO BE COMPARED TO THE TOTAL LABORATORY EXHAUST AIR VOLUME AND THE SUPPLY MODULATED SUCH THAT THE TOTAL EXHAUST EXCEEDS THE SUPPLY AIR VOLUME BY THE REQUIRED SCHEDULED OFFSET (SUPPLY TRACKS EXHAUST). TOTAL LABORATORY EXHAUST AIR VOLUME IS THE SUM OF THE GENERAL EXHAUST AIRFLOW VALUE, THE MULTIPLE FUME HOOD EXHAUST FLOW VALUES (WHERE APPLICABLE), AND THE EQUIPMENT EXHAUST FLOW VALUES (WHERE APPLICABLE). TOTAL LABORATORY SUPPLY AIR VOLUME SHALL NOT DROP BELOW THE SCHEDULED MINIMUM OCCUPIED AND UNOCCUPIED AIRFLOWS. AIRFLOWS SHALL BE MEASURED IN REAL TIME.
4. THE LAB SPACE TEMPERATURE SETPOINT IS MAINTAINED BY MODULATING OF THE HEATING VALVE(S). IN THE EVENT THAT THE SUPPLY AIRFLOW SIGNAL IS OUT OF RANGE (AS IN THE CASE OF REDUCED AIR HANDLING SUPPLY CAPACITY), THE LAB GENERAL EXHAUST VALVE SHALL BE COMMANDED FULLY CLOSED AND THE SPACE TEMPERATURE ALLOWED TO RISE ABOVE SETPOINT (TO REDUCE THE EXCESS NEGATIVE PRESSURE POTENTIAL IN THE BUILDING)
5. LARGE LAB SPACES CONSISTING OF MULTIPLE LAB CONTROL SYSTEM MODULES WHERE THERE ARE MULTIPLE SPACE SENSORS INSTALLED WITHIN THE BOUNDING WALLS OF THE SPACE SHALL HAVE PROVISIONS PROGRAMMED TO WEIGHT INDIVIDUAL SENSORS (DEFAULT EQUAL WEIGHTING) AND TO UTILIZE THE LOW, HIGH OR AVERAGE SENSOR AS THE SPACE SENSOR INPUT FOR ALL LAB SYSTEM MODULES IN THE MULTIPLE LAB SYSTEM MODULE SPACE. THE CONTROLLER SHALL PROHIBIT DIFFERING SPACE SENSOR SETTINGS WHICH WOULD LEAD TO HEATING ONE PORTION OF THE LARGE LAB SPACE WHILE ANOTHER PORTION IS CALLING FOR COOLING.
6. PROVIDE DISCREET OUTPUTS FOR EACH AIR VALVE (LTB OR LGEV) IN A GIVEN LAB CONTROLLER SO THAT EACH AIR VALVE OUTPUT CAN BE SCALED TO MATCH ACTUAL DELIVERED AIRFLOW AS DETERMINED THROUGH THE TAB PROCESS.
7. PROVIDE ALL HARDWARE AND SOFTWARE FOR ALL SIGNALS TO BE COMPLETELY CONTAINED WITHIN THE INDIVIDUAL LABORATORY. NO NECESSARY SIGNALS SHALL PASS IN NOR OUT OF THE PHYSICAL LIMITS OF THE LAB EXCEPT FOR TIME/DATE INFORMATION AND THE DEMAND INDICATORS.
8. TIME SCHEDULE AND OCCUPANCY SENSORS ARE UTILIZED TO RESET SPACE MINIMUM AIRCHANGE RATES (NO RESET / SETBACK OF THE LAB SPACE TEMPERATURES). SCHEDULED SPACE OCCUPIED MODE FOR THE LABS SHALL BE: OCCUPIED DAYTIME FROM - 7:00 A.M. TO 6:00 P.M., 365 DAYS PER YEAR. SCHEDULED SPACE UNOCCUPIED MODE IS AT ALL OTHER TIMES. SENSING OF OCCUPANCY DURING UNOCCUPIED MODE RETURNS THE SPACE TO OCCUPIED SPACE TEMPERATURE SETPOINTS. SENSING OF NO OCCUPANCY DURING THE SCHEDULED OCCUPIED MODE DOES NOT REVISE THE AIRFLOW SETPOINTS TO THE UNOCCUPIED SETTINGS.
- SEQUENCE OF OPERATION

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

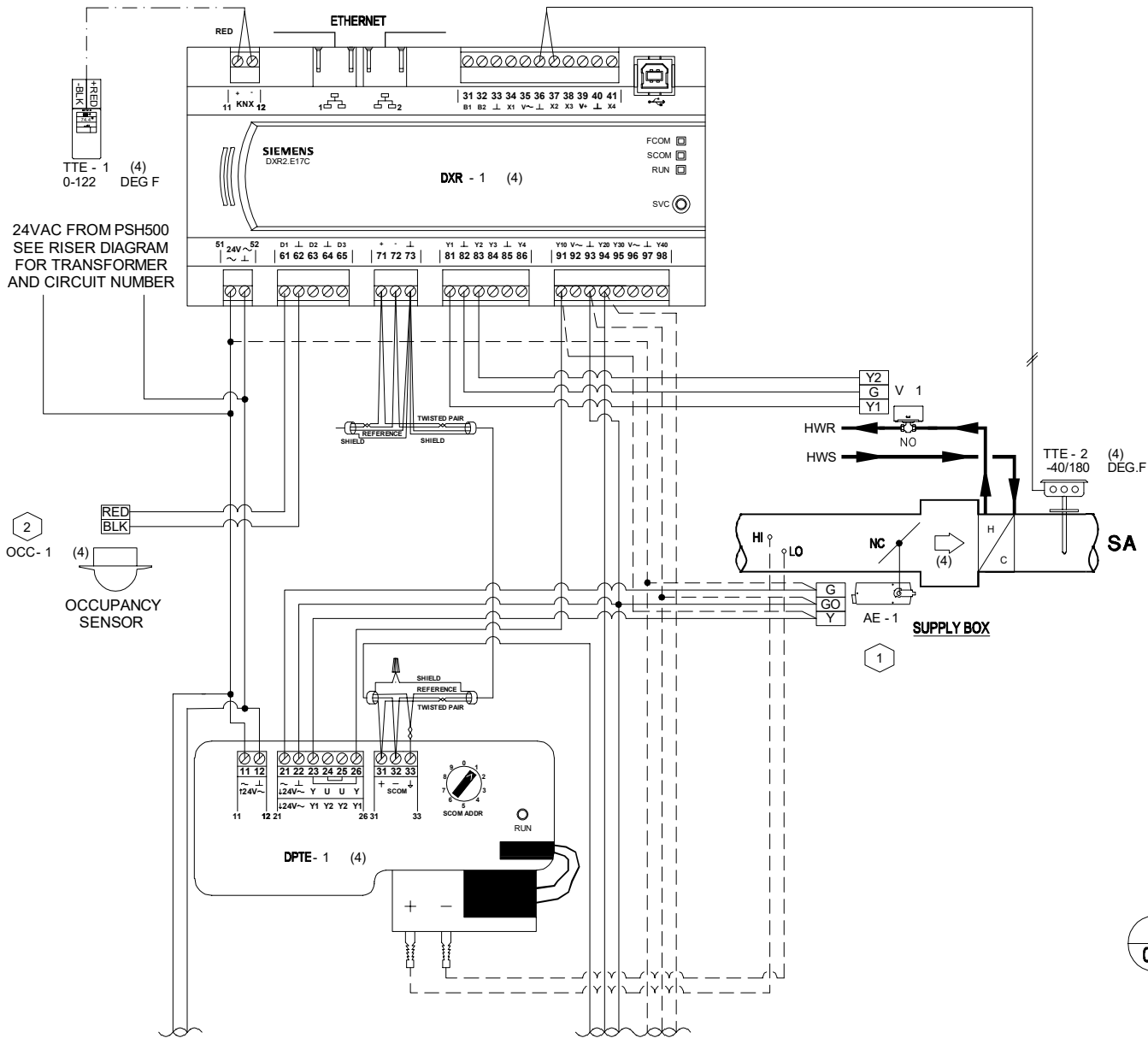
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Chemistry LRC - LTB/LGEV Fast Act

440P-388762

029



TO TERMINALS ON
DXR CONTROLLER

TO TERMINALS ON
DXR CONTROLLER



Indianapolis Smart Infrastructure

IU Chemistry Gnd-1st Flr Labs
IU PROJECT #20231351,

Chemistry LRC - LTB/LGEV Fast Act

440P-387655

031

BASE BID

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	40	GDE161.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5NM
DPTE 1-2	40	DXA.S04P1	SIEMENS	N/A	AIR FLOW PRES SENSOR 1"
DXR 1	20	DXR2.E17C-103B	SIEMENS	N/A	DXR2.E17C-103B AUTOMATION STATION
OCC 1	9	FBO	N/A	N/A	FURNISHED BY OTHERS
TTE 1	20	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE 2	20	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

ALTERNATE 3 (3) ALTERNATE 4 (1)

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	8	GDE161.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5NM
DPTE 1-2	8	DXA.S04P1	SIEMENS	N/A	AIR FLOW PRES SENSOR 1"
DXR 1	4	DXR2.E17C-103B	SIEMENS	N/A	DXR2.E17C-103B AUTOMATION STATION
OCC 1	4	FBO	N/A	N/A	FURNISHED BY OTHERS
TTE 1	4	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE 2	4	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

SEQUENCE OF OPERATION – TERMINAL BOXES WITH PAIRED AIRFLOW CONTROL VALVE EXHAUST:

OCCUPIED MODE:

1. TERMINAL BOX CONTROLLER SHALL RESPOND TO CHANGES IN SPACE TEMPERATURE AND VARIATIONS IN SYSTEM STATIC PRESSURE (PRESSURE INDEPENDENT) TO MODULATE SUPPLY AIR VOLUME VALVE FROM SCHEDULED MINIMUM TO MAXIMUM. WHEN THE BOX HEATING IS REQUIRED, HEATING COIL TO MODULATE OPEN AND PROVIDE UP TO A MAXIMUM OF 90°F (ADJ.) LEAVING AIR TEMPERATURE. BOX HEATING AIRFLOW IS THEN MODULATED FROM HEATING MINIMUM TO MAXIMUM HEATING AIRFLOW TO MAINTAIN APPROXIMATELY 90°F +/-5.0°F (ADJ.) DISCHARGE TEMPERATURE AS ADDITIONAL HEAT IS REQUIRED. THROUGH LAN TO OPERATORS' WORKSTATION. IT SHALL BE POSSIBLE TO READ AND ADJUST SPACE TEMPERATURE AND SUPPLY AIR VOLUME (MAXIMUMS AND MINIMUMS).
2. PRESSURE-INDEPENDENT AIRFLOW CONTROL VALVE (AFCV) SHALL BE CONTROLLED IN SEQUENCE WITH SUPPLY AIR TERMINAL BOX FROM MINIMUM FLOW TO MAXIMUM FLOW TO MAINTAIN THE DESIGN AIR FLOW DIFFERENTIAL IN EACH ROOM.

3. WHERE RADIANT HEAT IS USED, THE RADIANT HEAT CONTROL VALVE SHALL TRACK AHEAD OF THE TERMINAL HEATING COIL VALVE OUTPUT BY A FACTOR OF 3.0 (ADJ) (E.G. WHEN THE RADIANT VALVE IS OPEN 90%, THE TERMINAL HEATING COIL VALVE WILL BE OPEN 30%). ABOVE 45°F (ADJ) OUTDOOR AIR TEMPERATURE, OR WHILE THE SUPPLY AIR TEMPERATURE IS LESS THAN THE SPACE TEMPERATURE SET POINT, THE RADIANT HEAT VALVE IS FORCED FULLY CLOSED.
4. TIME SCHEDULE AND OCCUPANCY SENSORS ARE UTILIZED TO RESET SPACE DEADBAND TEMPERATURES IN ACCORDANCE WITH THE FACILITY'S TEMPERATURE SETBACK POLICY:
–OCCUPIED MODE (ROOM OCCUPANCY SENSED)
HEATING SET POINT = 70°F
COOLING SET POINT = 76°F
TERMINAL BOX AIR VALVE CONTROLS TO AIRFLOW SETPOINT.
–STANDBY MODE (BUILDING OCCUPANCY SCHEDULED ON, ROOM OCCUPANCY NOT SENSED FOR 30 MINUTES)
HEATING SET POINT = 70°F
COOLING SET POINT = 78°F
TERMINAL BOX AIR VALVE CONTROLS TO AIRFLOW SETPOINT.

UNOCCUPIED MODE (SEE ROOM LIST AS TO WHICH ROOMS GET THIS PROGRAMMING):

1. THE SPACE SHALL BE INDEXED FROM OCCUPIED TO UNOCCUPIED MODES BY A TIME PROGRAM IN THE CAMPUS BAS. INITIAL UNOCCUPIED CYCLE SHALL BE PROGRAMMED BY ECC FROM 8:00PM TO 6:00AM MONDAY THROUGH FRIDAY; BEFORE 7:00AM AND AFTER 5:00PM SATURDAY; AND ALL DAY ON SUNDAYS AND HOLIDAYS. COORDINATE HOURS AND DAY SCHEDULING WITH THE OWNER PRIOR TO TURNOVER.
2. THE SPACES SHALL INDEXED INTO UNOCCUPIED MODE AND OUT OF UNOCCUPIED MODE IN A STAGGERED FASHION. THE FIRST GROUP OF SPACES CONSISTING OF 15% OF THE TOTAL SPACES WITH THIS CONTROL SEQUENCE SHALL BE INDEXED AT THE TIMES NOTED ABOVE. THE SECOND GROUP OF SPACES CONSISTING OF THE NEXT 20% OF THE TOTAL SPACES SHALL BE INDEXED THREE MINUTES AFTER THE FIRST GROUP. THE THIRD GROUP OF SPACES CONSISTING OF THE NEXT 20% OF THE TOTAL SPACES SHALL BE INDEXED THREE MINUTES AFTER THE SECOND GROUP. THE FOURTH GROUP OF SPACES CONSISTING OF THE NEXT 20% OF THE TOTAL SPACES SHALL BE INDEXED THREE MINUTES AFTER THE THIRD GROUP. THE LAST GROUP OF SPACES CONSISTING OF THE REMAINDER OF THE TOTAL SPACES SHALL BE INDEXED THREE MINUTES AFTER THE FOURTH GROUP.
3. TIME SCHEDULE IS UTILIZED TO RESET SPACE DEADBAND TEMPERATURES AND CLOSE TERMINAL BOXES IN ACCORDANCE WITH THE FACILITY'S TEMPERATURE SETBACK POLICY:
–UNOCCUPIED MODE (SPACE OCCUPANCY SCHEDULED OFF)
HEATING SET POINT = 63°F
COOLING SET POINT = 80°F
4. EACH TERMINAL BOX HEATING VALVE SHALL CLOSE WHEN ITS ASSOCIATED AHU IS DE-ENERGIZED.

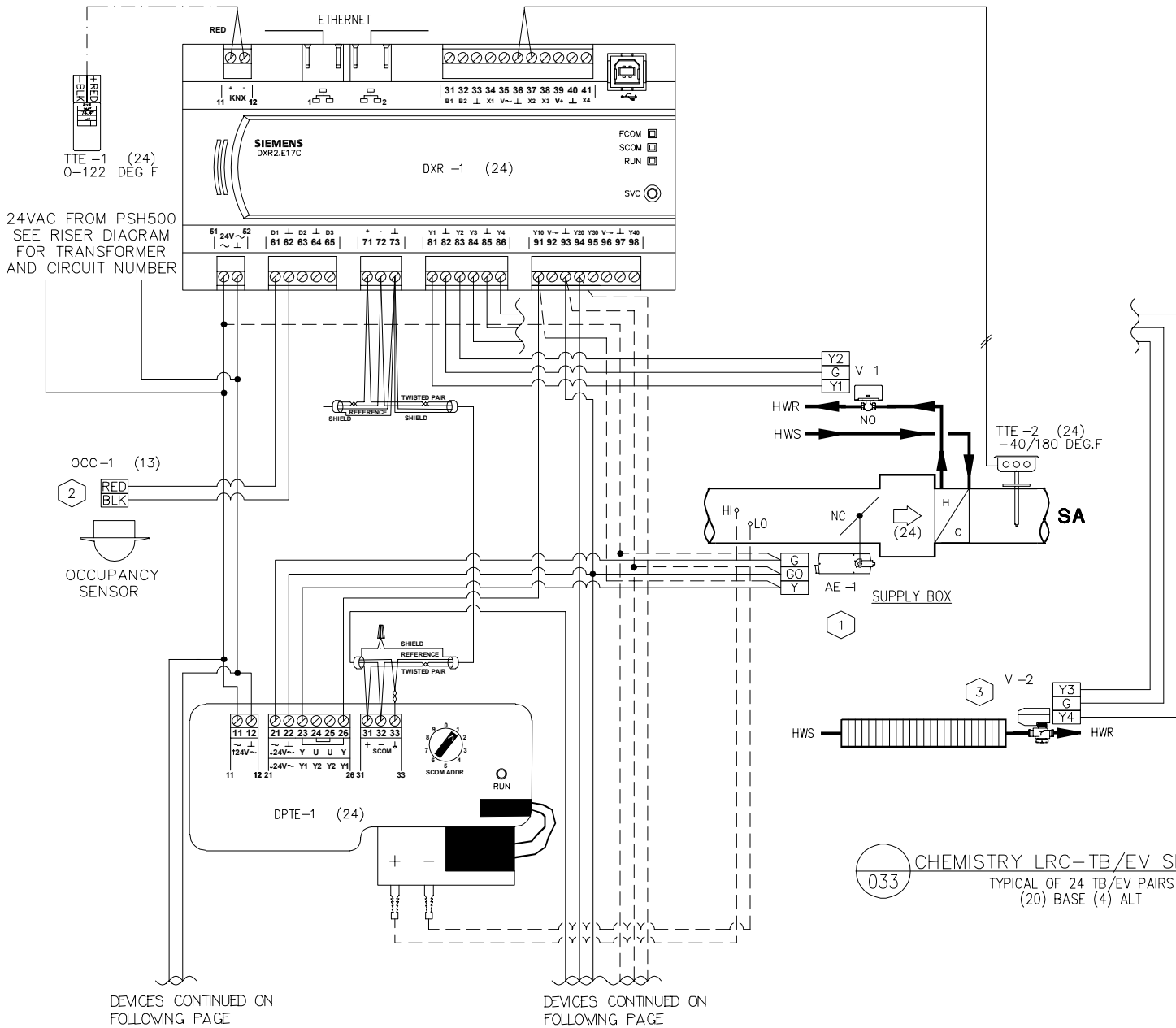
SEQUENCE OF OPERATION – CAV BOXES:

1. TERMINAL BOX CONTROLLER SHALL RESPOND TO CHANGES IN SPACE TEMPERATURE BY MODULATING HEATING COIL VALVE. SUPPLY AIR VOLUME IS TO BE MAINTAINED AT A CONSTANT VALUE REGARDLESS OF CHANGES IN SUPPLY DUCT STATIC PRESSURE THROUGH CONTROL OF DAMPER ACTUATOR. THROUGH LAN TO OPERATORS WORKSTATION IT SHALL BE POSSIBLE TO READ AND ADJUST SPACE TEMPERATURE AND SUPPLY AIR VOLUMES (MAXIMUM AND MINIMUMS).
2. FINNED TUBE RADIANT VALVE CONTROL, HEATING COIL, AND OCCUPIED/UNOCCUPIED TEMPERATURE SETBACK SEQUENCES MATCH VAV SEQUENCE.

TEMPERATURE SPACE SENSORS:
EACH TERMINAL UNIT SHALL UTILIZE SPACE SENSORS NOTED BELOW UNLESS NOTED OTHERWISE ON THE PLANS:

THERMOSTAT: WALL-MOUNTED SPACE SENSOR.

REVISION HISTORY		SIEMENS		IU Research Labs Renovation				440P-388762											
		Indianapolis Smart Infrastructure		3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089		IU PROJECT #20240397,													
				<table><tr><td>ENGINEER</td><td>DRAFTER</td><td>CHECKED BY</td><td>INITIAL RELEASE</td><td>LAST EDIT DATE</td></tr><tr><td>WLH</td><td>WLH</td><td></td><td>01/17/25</td><td>01/20/25</td></tr></table>		ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE	WLH	WLH		01/17/25	01/20/25	032			
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE															
WLH	WLH		01/17/25	01/20/25															
				Chemistry LRC - TB/EV Slow Act															



- INSTALLATION NOTES:
- 1 DAMPER ACTUATOR MAY BE WIRED EITHER DIRECTLY FROM THE DXR OR FROM THE DXR TO THE APS (DPTE) THEN TO THE DAMPER ACTUATOR.
 - 2 OCCUPANCY INPUT IS FURNISHED AND INSTALLED BY THE EC. THE WIRING FROM THE OCCUPANCY INPUT TO THE TERMINAL UNIT CONTROLLER IS FURNISHED, INSTALLED, AND COMMISSIONED BY THE CIC.
TYPICAL OF 13 LRC'S WITH OCCUPANCY INPUTS: 103C, 103D, A122, A132, A142, A150, A150A, A150B, A150C, A162, A162A, A162B, & A251.
 - 3 TYPICAL OF 11 LRC'S WITH FIN TUBE RADIATION: 103B, 103C, 103D, A122, A140A, A140B, A140C, A150A, A150B, A150C, & A162B.

DATA POINTS (30 MAX)	
PHYSICAL	6
KNX	3
TOTAL	9

KNX LOADS (50mA MAX)	
TTE-2	10mA
TOTAL	10mA

24 VAC LOADS	
DXR-1	8VA
AE-1	X
OCCB-1	X
V-1	X
V-2	X
TOTAL	22VA

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

Chemistry LRC - TB/EV Slow Act

440P-388762

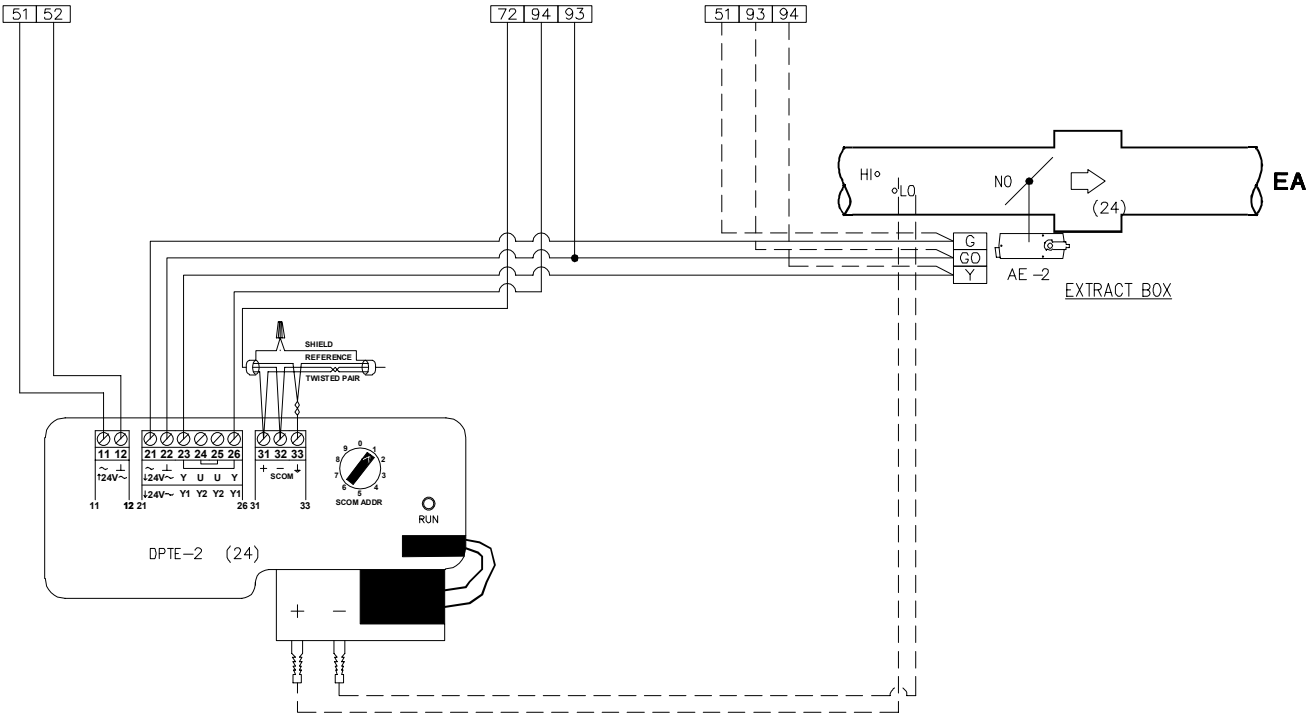
033

DEVICES CONTINUED FROM
PREVIOUS PAGE

TO TERMINALS ON
DXR CONTROLLER

TO TERMINALS ON
DXR CONTROLLER

TO TERMINALS ON
DXR CONTROLLER



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

Chemistry LRC - TB/EV Slow Act

44OP-388762

034

BASE BID:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1	25	SEE HEV SCHEDULE	N/A	N/A	N/A
AVW 1	25	SEE HEV SCHEDULE	N/A	N/A	N/A
DPTE 1	25	SEE HEV SCHEDULE	N/A	N/A	N/A
DXR 1	25	SEE HEV SCHEDULE	N/A	N/A	N/A
ODP 1	25	QMX3.P87-1WSC	SIEMENS	N/A	WALL MOUNT FUME HOOD ODP (PL-LINK)
PSE 1	25	S55376-C159	SIEMENS	N/A	DXA.B200 SASH SENSOR

ALTERNATE #4:

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1	4	SEE HEV SCHEDULE	N/A	N/A	N/A
AVW 1	4	SEE HEV SCHEDULE	N/A	N/A	N/A
DPTE 1	4	SEE HEV SCHEDULE	N/A	N/A	N/A
DXR 1	4	SEE HEV SCHEDULE	N/A	N/A	N/A
ODP 1	4	QMX3.P87-1WSC	SIEMENS	N/A	WALL MOUNT FUME HOOD ODP (PL-LINK)
PSE 1	4	S55376-C159	SIEMENS	N/A	DXA.B200 SASH SENSOR

SEQUENCE OF OPERATION

1. LABORATORY HOOD FACE VELOCITY IS TO BE MAINTAINED AT A CONSTANT 80 FPM AS THE VERTICAL SASH (AND COMBINATION HORIZONTAL SASHES AS APPLICABLE) MOVES THROUGH USE OF SASH POSITION SENSING. VOLUME CONTROLLER MODULATES FHEV IN EXHAUST DUCT TO MAINTAIN CONSTANT FACE VELOCITY. FUME HOOD EXHAUST SHALL VARY TO MAINTAIN FACE VELOCITY WHILE NOT VARYING BELOW THE MINIMUM AIRFLOW VALUE (200 CFM FOR A SIX FOOT WIDE FUME HOOD; 175 CFM FOR A FIVE FOOT WIDE FUME HOOD; 150 CFM FOR A FOUR FOOT WIDE FUME HOOD; 125 CFM FOR A THREE FOOT WIDE FUME HOOD; 100 CFM FOR A TWO FOOT WIDE FUME HOOD). THE MAXIMUM AIRFLOW AT 80 FPM AT 18" SASH HEIGHT (675 CFM IN A SIX FOOT HOOD; 550 CFM IN A FIVE FOOT HOOD; 425 CFM IN A FOUR FOOT HOOD) SHALL NOT BE EXCEEDED WHEN THE SASH IS RAISED ABOVE 18" (FACE VELOCITY WILL DROP BELOW SETPOINT AS SASH IS RAISED ABOVE 18" AND ALARM WHEN LOW FACE VELOCITY LIMIT IS REACHED).
2. SPACE TEMPERATURE TO BE MAINTAINED AT AN OCCUPIED CONTROL SETPOINT THROUGH MODULATION OF THE LAB GENERAL EXHAUST VALVE WHICH ACHIEVING THE SCHEDULED AIRFLOW OFFSET. SUPPLY AIRFLOW TRACKS EXHAUST AIRFLOW.
- A. MODULATE LAB GENERAL EXHAUST VALVE FROM THE MINIMUM AIRFLOW TO THE MAXIMUM (SUM OF THE CONNECTED GRILLES AND DIFFUSERS) TO MAINTAIN SPACE TEMPERATURE COOLING. THE MINIMUM LGEV AIRFLOWS SHALL BE 25 CFM FOR A SIZE 6", 40 CFM FOR A SIZE 7", 60 CFM FOR A SIZE 8", 80 CFM FOR A SIZE 9", 100 CFM FOR A SIZE 10", 120 CFM FOR A SIZE 12", 200 CFM FOR A SIZE 14", AND 400 CFM FOR A SIZE 16".
- B. WHEN SPACE HEATING IS REQUIRED, THE HEATING COIL HYDRONIC VALVE IS MODULATED OPEN.
3. THE TOTAL SUPPLY AIR VOLUME IS TO BE COMPARED TO THE TOTAL LABORATORY EXHAUST AIR VOLUME AND THE SUPPLY MODULATED SUCH THAT THE TOTAL EXHAUST EXCEEDS THE SUPPLY AIR VOLUME BY THE REQUIRED SCHEDULED OFFSET (SUPPLY TRACKS EXHAUST). TOTAL LABORATORY EXHAUST AIR VOLUME IS THE SUM OF THE GENERAL EXHAUST AIRFLOW VALUE, THE MULTIPLE FUME HOOD EXHAUST FLOW VALUES (WHERE APPLICABLE), AND THE EQUIPMENT EXHAUST FLOW VALUES (WHERE APPLICABLE). TOTAL LABORATORY SUPPLY AIR VOLUME SHALL NOT DROP BELOW THE SCHEDULED MINIMUM OCCUPIED AND UNOCCUPIED AIRFLOWS. AIRFLOWS SHALL BE MEASURED IN REAL TIME.
4. THE LAB SPACE TEMPERATURE SETPOINT IS MAINTAINED BY MODULATING OF THE HEATING VALVE(S). IN THE EVENT THAT THE SUPPLY AIRFLOW SIGNAL IS OUT OF RANGE (AS IN THE CASE OF REDUCED AIR HANDLING SUPPLY CAPACITY), THE LAB GENERAL EXHAUST VALVE SHALL BE COMMANDED FULLY CLOSED AND THE SPACE TEMPERATURE ALLOWED TO RISE ABOVE SETPOINT (TO REDUCE THE EXCESS NEGATIVE PRESSURE POTENTIAL IN THE BUILDING)
5. LARGE LAB SPACES CONSISTING OF MULTIPLE LAB CONTROL SYSTEM MODULES WHERE THERE ARE MULTIPLE SPACE SENSORS INSTALLED WITHIN THE BOUNDING WALLS OF THE SPACE SHALL HAVE PROVISIONS PROGRAMMED TO WEIGHT INDIVIDUAL SENSORS (DEFAULT EQUAL WEIGHTING) AND TO UTILIZE THE LOW, HIGH OR AVERAGE SENSOR AS THE SPACE SENSOR INPUT FOR ALL LAB SYSTEM MODULES IN THE MULTIPLE LAB SYSTEM MODULE SPACE. THE CONTROLLER SHALL PROHIBIT DIFFERING SPACE SENSOR SETTINGS WHICH WOULD LEAD TO HEATING ONE PORTION OF THE LARGE LAB SPACE WHILE ANOTHER PORTION IS CALLING FOR COOLING.
6. PROVIDE DISCREET OUTPUTS FOR EACH AIR VALVE (LTB OR LGEV) IN A GIVEN LAB CONTROLLER SO THAT EACH AIR VALVE OUTPUT CAN BE SCALED TO MATCH ACTUAL DELIVERED AIRFLOW AS DETERMINED THROUGH THE TAB PROCESS.
7. PROVIDE ALL HARDWARE AND SOFTWARE FOR ALL SIGNALS TO BE COMPLETELY CONTAINED WITHIN THE INDIVIDUAL LABORATORY. NO NECESSARY SIGNALS SHALL PASS IN NOR OUT OF THE PHYSICAL LIMITS OF THE LAB EXCEPT FOR TIME/DATE INFORMATION AND THE DEMAND INDICATORS.
8. TIME SCHEDULE AND OCCUPANCY SENSORS ARE UTILIZED TO RESET SPACE MINIMUM AIRCHANGE RATES (NO RESET / SETBACK OF THE LAB SPACE TEMPERATURES). SCHEDULED SPACE OCCUPIED MODE FOR THE LABS SHALL BE: OCCUPIED DAYTIME FROM - 7:00 A.M. TO 6:00 P.M., 365 DAYS PER YEAR. SCHEDULED SPACE UNOCCUPIED MODE IS AT ALL OTHER TIMES. SENSING OF OCCUPANCY DURING UNOCCUPIED MODE RETURNS THE SPACE TO OCCUPIED SPACE TEMPERATURE SETPOINTS. SENSING OF NO OCCUPANCY DURING THE SCHEDULED OCCUPIED MODE DOES NOT REVISE THE AIRFLOW SETPOINTS TO THE UNOCCUPIED SETTINGS.

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

IU Research Labs Renovation

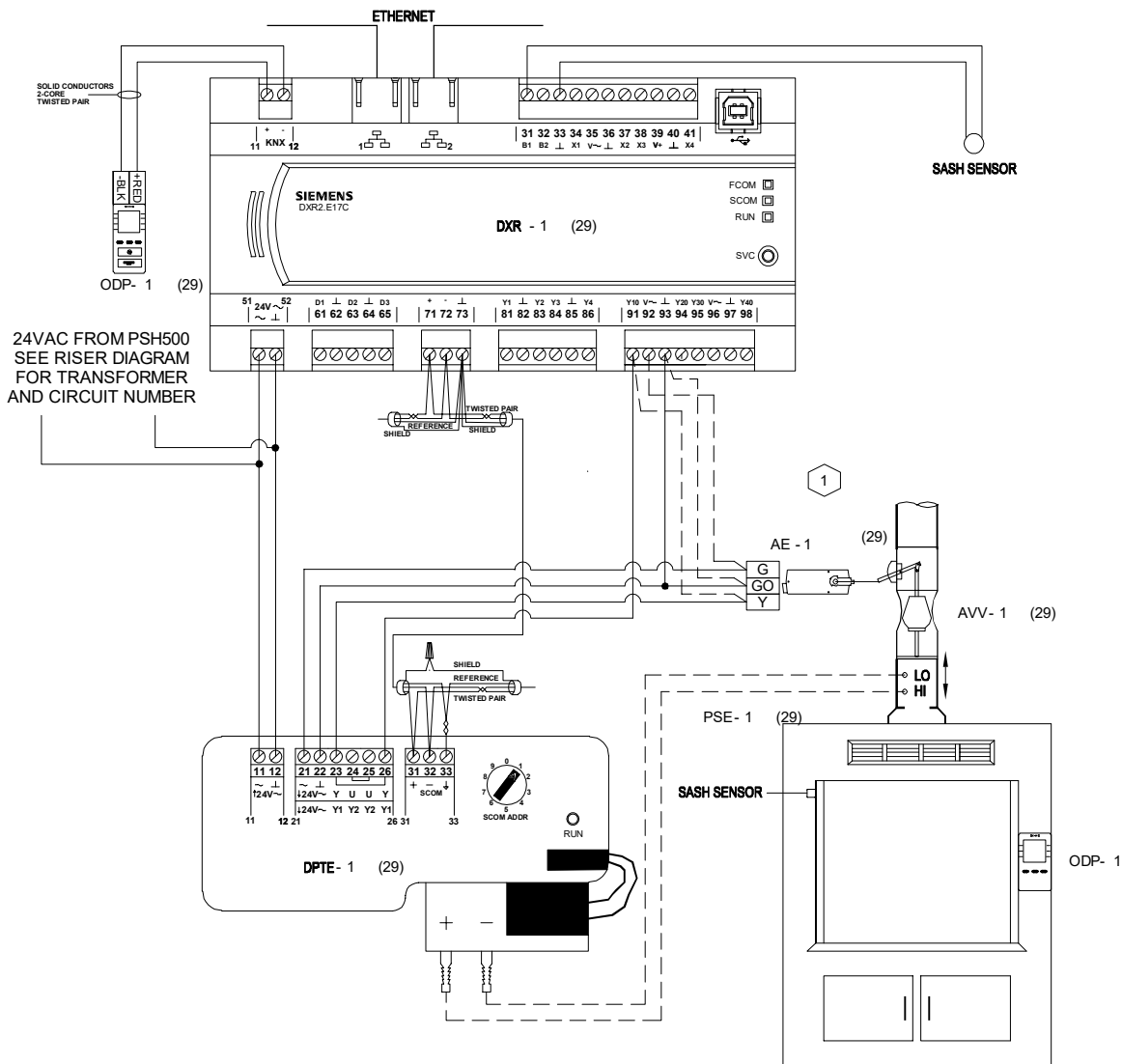
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Chemistry FHC Single Vertical

440P-388762

035



INSTALLATION NOTES:

- 1 DAMPER ACTUATOR MAY BE WIRED EITHER DIRECTLY FROM THE DXR OR FROM THE DXR TO THE APS (DPTE) THEN TO THE DAMPER ACTUATOR.

036 CV2 FHC - MODULATING VENTURI
TYPICAL OF (29) SINGLE VERTICAL FUME HOODS
(25) BASE (4) ALTERNATE #4

DATA POINTS (30 MAX)	
PHYSICAL	4
KNX	3
TOTAL	7

KNX LOADS (50mA MAX)	
ODP-1	8mA
TOTAL	8mA

24 VAC LOADS	
DXR-1	8VA
AE-1	X
OCOB-1	X
TOTAL	8VA

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/16/25

Chemistry FHC Single Vertical

440P-388762

036

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1	2	GDE131.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5Nm
DXR 1	2	DXR2.E12P-102B	SIEMENS	A6V10502844	DXR2.E12P Room Automation Station
OCC 1	2	FB0	N/A	N/A	FURNISHED BY OTHERS
TTE 1	2	QMX3.P30-1WSB	SIEMENS	N/A	QMX3 ROOM TEMP ONLY (COO=USA)
TTE 2	2	QAM2030.010	SIEMENS	149915	DUCT POINT TEMP, 10K OHM TYPE 2, 4"
V					SEE VALVE SUBMITTAL

SEQUENCE OF OPERATION – TERMINAL BOXES WITH NO PAIRED EXHAUST:

OCCUPIED MODE:

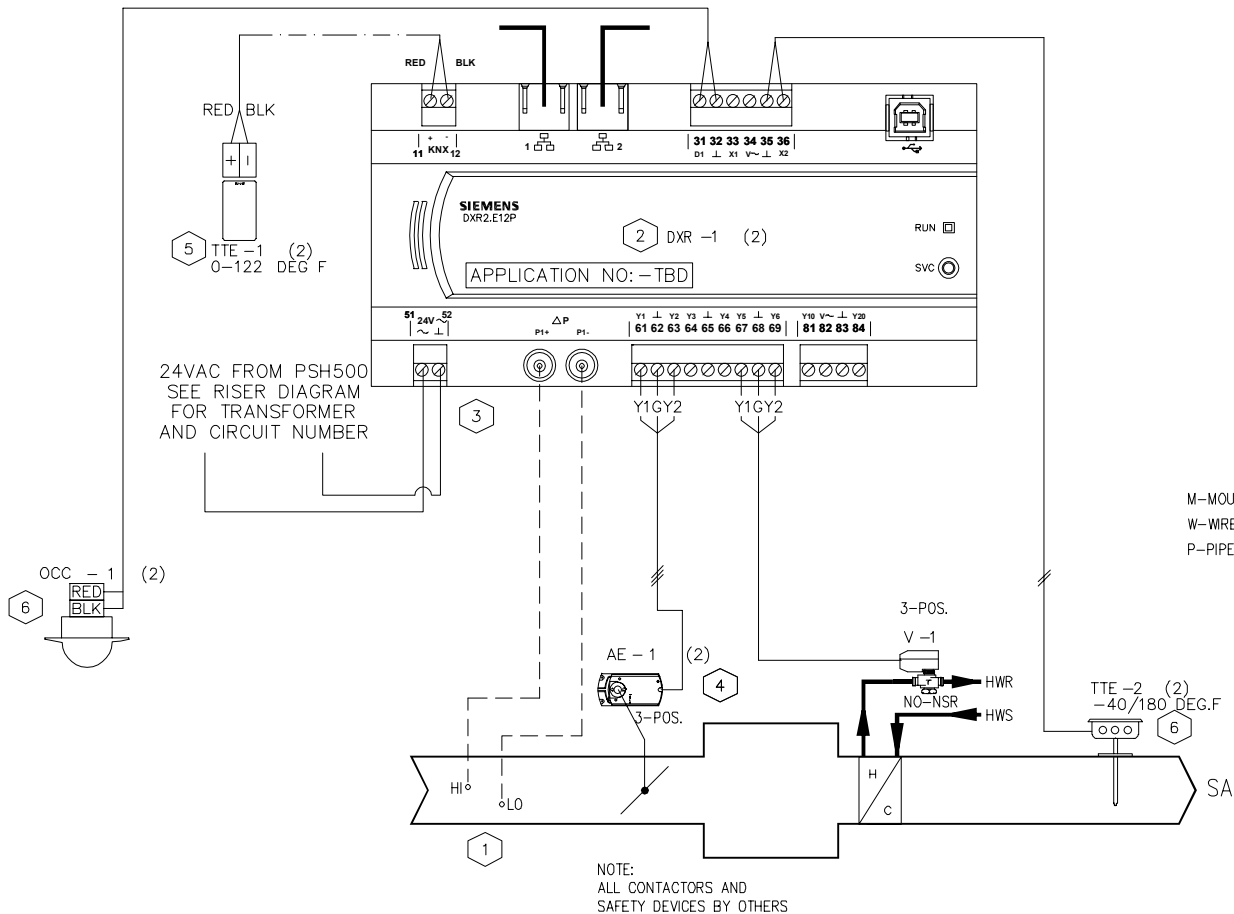
1. TERMINAL BOX CONTROLLER SHALL RESPOND TO CHANGES IN SPACE TEMPERATURE AND VARIATIONS IN SYSTEM STATIC PRESSURE (PRESSURE INDEPENDENT) TO MODULATE SUPPLY AIR VOLUME VALVE FROM SCHEDULED MINIMUM TO MAXIMUM. WHEN THE BOX HEATING IS REQUIRED, HEATING COIL TO MODULATE OPEN AND PROVIDE UP TO A MAXIMUM OF 90°F (ADJ.) LEAVING AIR TEMPERATURE. BOX HEATING AIRFLOW IS THEN MODULATED FROM HEATING MINIMUM TO MAXIMUM HEATING AIRFLOW TO MAINTAIN APPROXIMATELY 90°F +/-5.0°F (ADJ.) DISCHARGE TEMPERATURE AS ADDITIONAL HEAT IS REQUIRED. THROUGH LAN TO OPERATORS' WORKSTATION. IT SHALL BE POSSIBLE TO READ AND ADJUST SPACE TEMPERATURE AND SUPPLY AIR VOLUME (MAXIMUMS AND MINIMUMS).
2. TIME SCHEDULE AND OCCUPANCY SENSORS ARE UTILIZED TO RESET SPACE DEADBAND TEMPERATURES IN ACCORDANCE WITH THE FACILITY'S TEMPERATURE SETBACK POLICY:
–OCCUPIED MODE (ROOM OCCUPANCY SENSED)
HEATING SET POINT = 70°F
COOLING SET POINT = 76°F
TERMINAL BOX AIR VALVE CONTROLS TO AIRFLOW SETPOINT.
–STANDBY MODE (BUILDING OCCUPANCY SCHEDULED ON, ROOM OCCUPANCY NOT SENSED FOR 30 MINUTES)
HEATING SET POINT = 70°F
COOLING SET POINT = 78°F
TERMINAL BOX AIR VALVE CONTROLS TO AIRFLOW SETPOINT.

UNOCCUPIED MODE:

1. THE SPACE SHALL BE INDEXED FROM OCCUPIED TO UNOCCUPIED MODES BY A TIME PROGRAM IN THE CAMPUS BAS. INITIAL UNOCCUPIED CYCLE SHALL BE PROGRAMMED BY ECC FROM 8:00PM TO 6:00AM MONDAY THROUGH FRIDAY; BEFORE 7:00AM AND AFTER 5:00PM SATURDAY; AND ALL DAY ON SUNDAYS AND HOLIDAYS. COORDINATE HOURS AND DAY SCHEDULING WITH THE OWNER PRIOR TO TURNOVER.
- COOLING SET POINT = 80°F

TEMPERATURE SPACE SENSORS:
EACH TERMINAL UNIT SHALL UTILIZE SPACE SENSORS NOTED BELOW UNLESS NOTED OTHERWISE ON THE PLANS:
THERMOSTAT: WALL-MOUNTED SPACE SENSOR.

REVISION HISTORY	SIEMENS		IU Research Labs Renovation					440P-388762		
	Indianapolis Smart Infrastructure		3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089		IU PROJECT #20240397,					
			ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE	037		
			WLH	WLH		01/17/25	01/16/25			
			Chemistry VAV w/ HW Reheat							



INSTALLATION NOTES:

- 1 VAV BOX INSTALLED BY MECHANICAL CONTRACTOR WITH 3 TO 5 STRAIGHT DUCT DIAMETERS UPSTREAM OF BOX TO PROVIDE PROPER FLOW SENSING
- 2 DXR2-1 TO BE MOUNTED IN MANUFACTURER SUPPLIED CONTROLLER ENCLOSURE
- 3 REFER TO BUILDING POWER TRUNK DRAWING FOR 24 VAC POWER
- 4 MOUNT ACTUATOR WITH DAMPER IN FULL OPEN POSITION. VERIFY DXR-1 AND ACTUATOR REQUIREMENT WITH THE BOX MANUFACTURER
- 5 LOCATE AS SHOWN ON FLOOR PLANS/CONTRACT DOCUMENTS
- 6 OCCUPANCY INPUT IS FURNISHED AND INSTALLED BY THE EC. THE WIRING FROM THE OCCUPANCY INPUT TO THE TERMINAL UNIT CONTROLLER IS FURNISHED, INSTALLED, AND COMMISSIONED BY THE CIC.

DEVICE	SIEMENS		MANUFACTURER	DIVISION 16	DIVISION 15
	FITTER	ELEC.			
TTE-1/2		M,W			
AE-1		M,W			
DXR2-1		M,W,P			
COMMS		W			
POWER (24VAC)		W			

M-MOUNTED
W-WIRED
P-PIPED

DATA POINTS (30 MAX)	
PHYSICAL	3
KNX	3
TOTAL	6

KNX LOADS (50mA MAX)	
TTE-1	10mA
TOTAL	10mA

24VAC LOADS	
DXR-1	6VA
AE-1	2.3VA
V-1	
TOTAL	8.3VA

038 VAV w/HW RHT (14023)
TYPICAL OF (2) OFFICES
041C AND 141B

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER DRAFTER CHECKED BY INITIAL RELEASE LAST EDIT DATE

WLH WLH 01/17/25 01/16/25

Chemistry VAV w/ HW Reheat

440P-388762

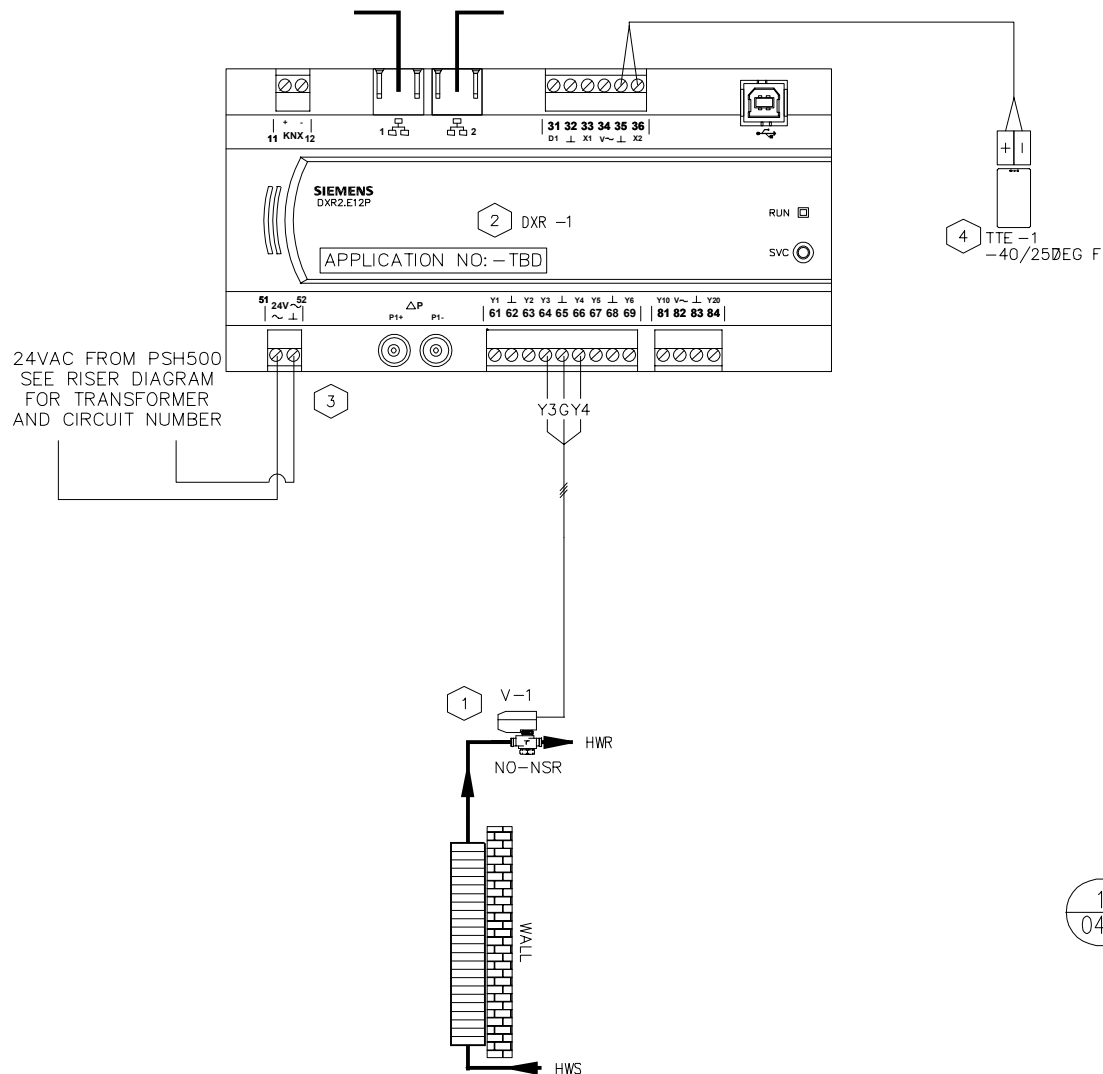
038

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
DXR 1	1	DXR2.M12P-102B	SIEMENS	A6V10502838	DXR2.M12P Room Automation Station
ENC 1	1	540-155	SIEMENS	N/A	TEC ENCL CTLR ONLY
TTE 1	1	540-984	SIEMENS	149 971	FLUSH MNT TEMP SNSR, 10K OHM TYP2, METAL
V					SEE VALVE SUBMITTAL

FINTUBE RADIATION - SEQUENCE OF OPERATION

ZONE TEMPERATURE CONTROL: THE RADIATION CONTROL VALVE SHALL BE FULLY CLOSED WHEN THE OUTDOOR AIR TEMPERATURE IS ABOVE 50 DEG F. (ADJ.). BELOW 50 DEG F (ADJ.) THE RADIATION CONTROL VALVE SHALL MODULATE TO MAINTAIN THE ROOM TEMPERATURE SETPOINT OF 71.0 DEG F. (ADJ.). INCLUDE THE RADIATION SENSOR READING AND IT'S SETPOINT ON THE GRAPHICS.

REVISION HISTORY		<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>	<div>3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089</div>	IU Research Labs Renovation					44OP-388762	
				IU PROJECT #20240397,					039	
				ENGINEER WLH	DRAFTER WLH	CHECKED BY	INITIAL RELEASE 01/17/25	LAST EDIT DATE 01/20/25		
				Chemistry FTR						



INSTALLATION NOTES:

- THE A140 SPACE HAS A SINGLE RADIATION CONTROL VALVE FOR THE LARGE SPACE.
- DXR2-1 TO BE MOUNTED IN MANUFACTURER SUPPLIED CONTROLLER ENCLOSURE
- REFER TO BUILDING POWER TRUNK DRAWING FOR 24 VAC POWER
- THE SPACE SENSOR SHALL BE A FLAT PLATE STAINLESS SENSOR WHICH IS INSULATED ON THE BACKSIDE (WALL SIDE) OF THE SENSOR WITH THE SENSOR MOUNTED ON VENTILATED STANDOFF WHICH ALLOWS ROOM AIR TO PASS BEHIND THE SENSOR.

1
040 FINTUBE RADIATION
TYPICAL OF 1
LAB A140

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

6200 TECHNOLOGY
3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH	RM	01/17/25	01/20/25

Chemistry FTR

440P-388762

040

ADD NEW LRC494070 TO EXISTING RISER TO CONTROL LAV 4-25B & LEV 4-25B.

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

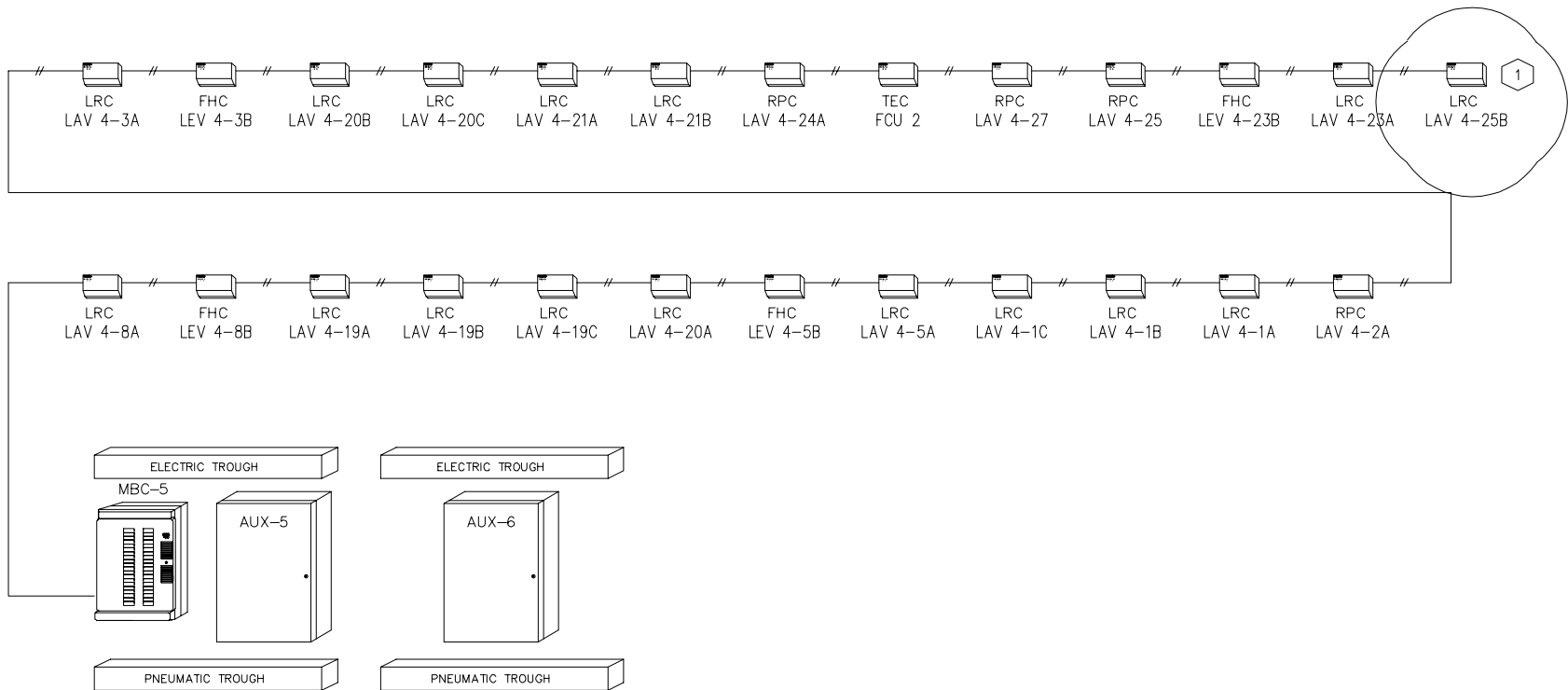
Simon Hall Riser

440P-388762

041

INSTALLATION NOTES:

- 1 EXTEND EXISTING FLN TRUNK TO ADD NEW LAV 4-25B (JANITOR RM 494).



AHU-5 & 6
BSMT AREA B

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

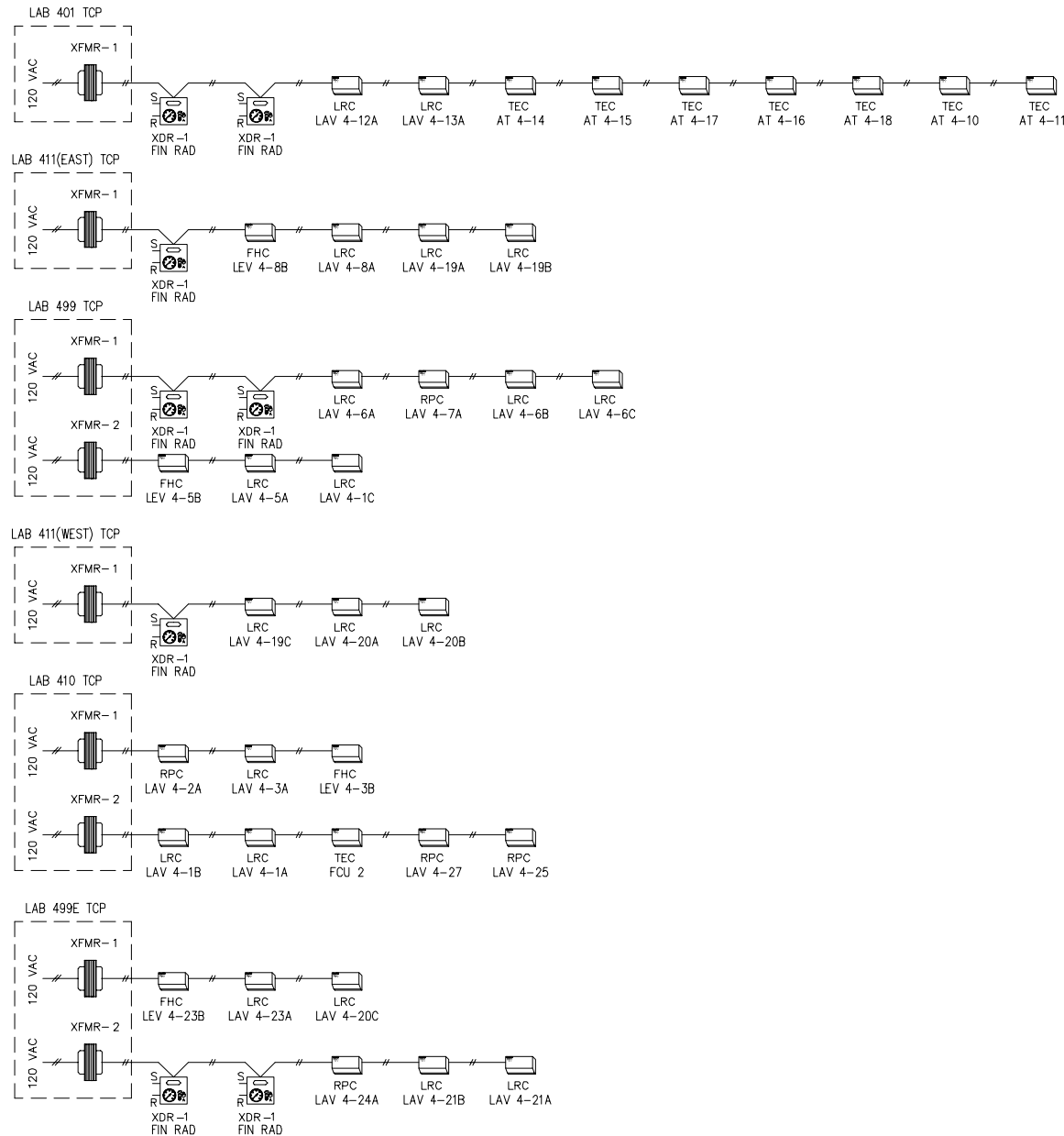
Simon Hall Riser

440P-388762

042

INSTALLATION NOTES:

1 COORDINATE WITH SIEMENS TO EXTEND AN EXISTING 24V POWER TRUNK TO LRC 4-25B CONTROLS.



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

Simon Hall Riser

440P-388762

043

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Field Mounted Devices					
AE 1-2	2	GDE131.1P	SIEMENS	154 011	ACT NSR PLENUM 24/108L 5Nm
CBL 1	1	588-100B	SIEMENS	N/A	6-WIRE 2-RJ11 RS CABLE 50'PLMN
RPC 1	1	R540-517	SIEMENS	N/A	PM PRESS CTLR W/AUTOZERO ELEC
TTE 1	1	QAA2280.FWSC	SIEMENS	149820	RTS, TEC/RJ-11, FULL HMI
TTE 2	1	536-811	SIEMENS	149 134	DCT PT TMP, 100K OHM, 4", BRACKET MNT
V					SEE VALVE SUBMITTAL

The Room Pressurization Controller (RPC) modulates the VAV supply and exhaust air dampers to maintain a fixed CFM differential between the volumes of supply and exhaust air in the space. The RPC controls the pressure in the space in the positive or negative mode based on the setting on the pressure mode switch. The central air handling unit provides both supply and exhaust air. The application specific controller uses electric actuation.

Positive Space Pressure

Positive pressure prevents infiltration from surrounding spaces (protective isolation). The supply airflow exceeds the exhaust CFM by programmed amount.

Negative Space Pressure

Negative pressure prevents infiltration to surrounding spaces (infectious isolation). The exhaust airflow exceeds the supply CFM by programmed amount.

Occupied

The controller maintains a programmed, fixed CFM differential flow between the supply and exhaust terminal units by monitoring the air velocity sensors at the supply and exhaust air terminal units and modulating the supply and exhaust air dampers.

The RPC monitors the room temperature sensor and modulates the supply dampers in sequence with the reheat valve to maintain the space temperature at set point. The supply air volume remains at minimum while the reheat valve is open.

If the RPC is unable to maintain the programmed differential flow between the supply and exhaust terminal units, an alarm is reported at the central monitoring station.

Unoccupied

The space is controlled as in the Occupied mode except using the Unoccupied space temperature set points.

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

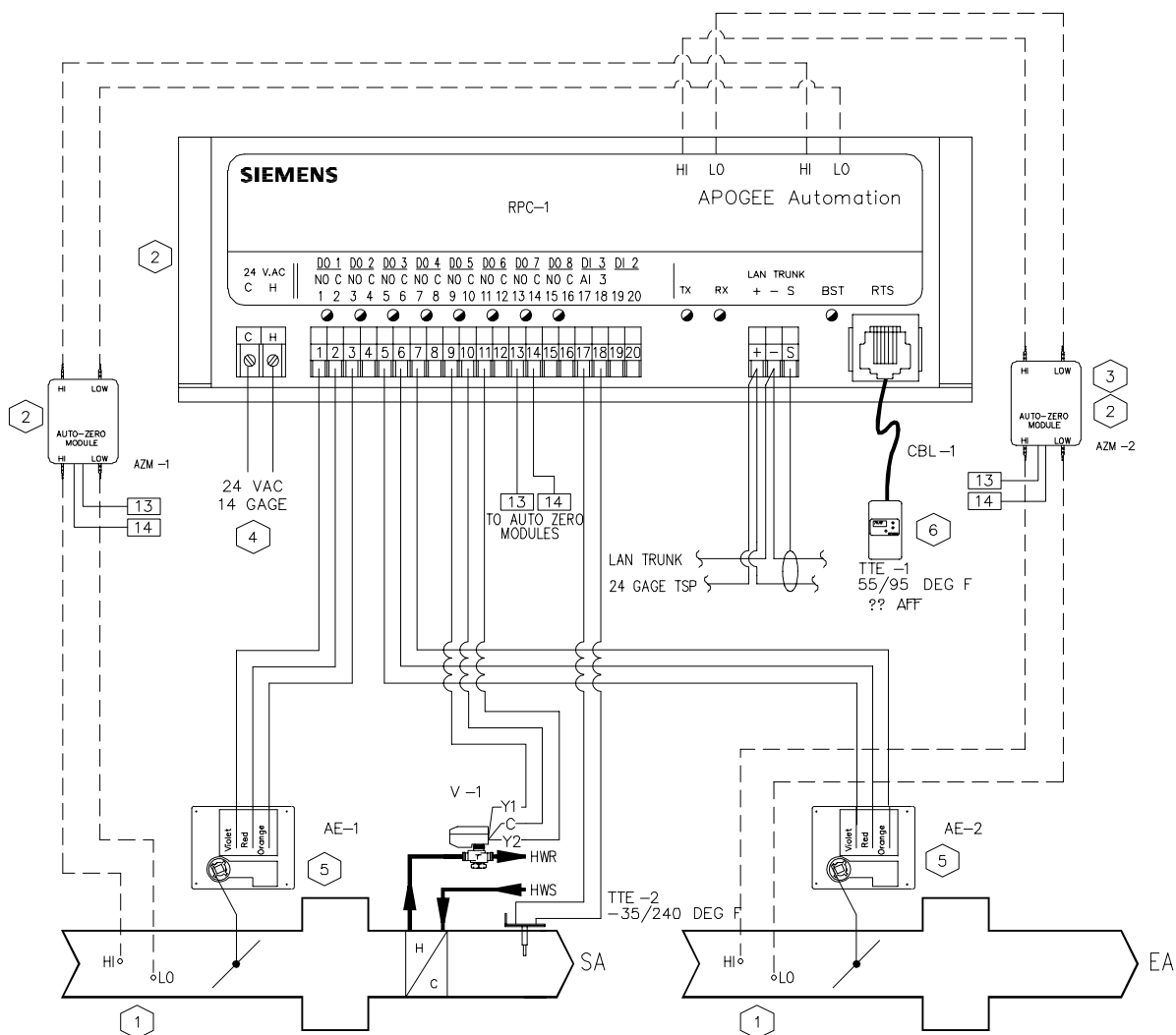
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

Simon VAV w/ HW Reheat

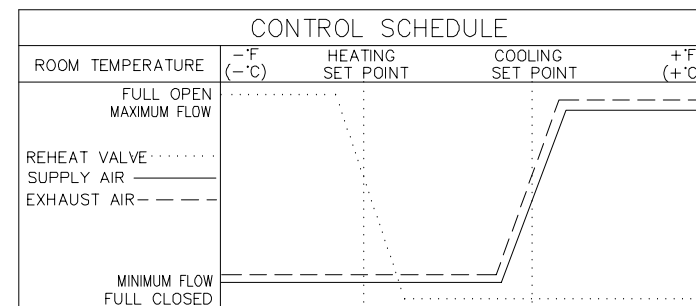
44OP-388762

044



INSTALLATION NOTES:

- 1 VAV BOX INSTALLED BY MECHANICAL CONTRACTOR WITH 3 TO 5 STRAIGHT DUCT DIAMETERS UPSTREAM OF THE BOX TO PROVIDE PROPER FLOW SENSING
- 2 RPC-1 AND AZM-1,2 TO BE MOUNTED IN MANUFACTURER SUPPLIED CONTROLLER ENCLOSURE
- 3 AZM-2 TO BE PIPED IN THE FIELD TO EXHAUST BOX
- 4 REFER TO BUILDING POWER TRUNK DRAWING FOR 24 VAC POWER
- 5 MOUNT ACTUATOR WITH DAMPER IN FULL OPEN POSITION. VERIFY RPC-1 AND ACTUATOR REQUIREMENT WITH THE BOX MANUFACTURER
- 5 LOCATE AS SHOWN ON FLOOR PLANS/CONTRACT DOCUMENTS



DEVICE	SIEMENS		MANUFACTURER	DIVISION 16	DIVISION 15
	FITTER	ELEC.			
TTE-1		M,W			
AE-1,2		M,W			
RPC-1		M,W,P			
V-1		W			M
LAN TRUNK		W			
POWER (24VAC)		W			
AZM-1		M,W,P			
AZM-2		M,W,P			

M-MOUNTED
W-WIRED
P-PIPED

045 RPC W/VAV, REHEAT COIL (2216)
LRC494070 (LAV 4-25B/LEV 4-25B)
SERVES: JANITOR RM 494

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 283-8880
Fax: 866 814-3089

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

Simon VAV w/ HW Reheat

440P-388762

045

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Existing Equipment To Remain					
PXCC 009000	1	PXC36-PE.A	SIEMENS	149454	APOGEE 36PT, P2 RS485/IP ALN
	1	LSM-FLN36.A	SIEMENS	N/A	FLN LICENSE FOR PXC36

ADD NEW EF-8 POINTS TO EXISTING PXCC-9 AS SHOWN.

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

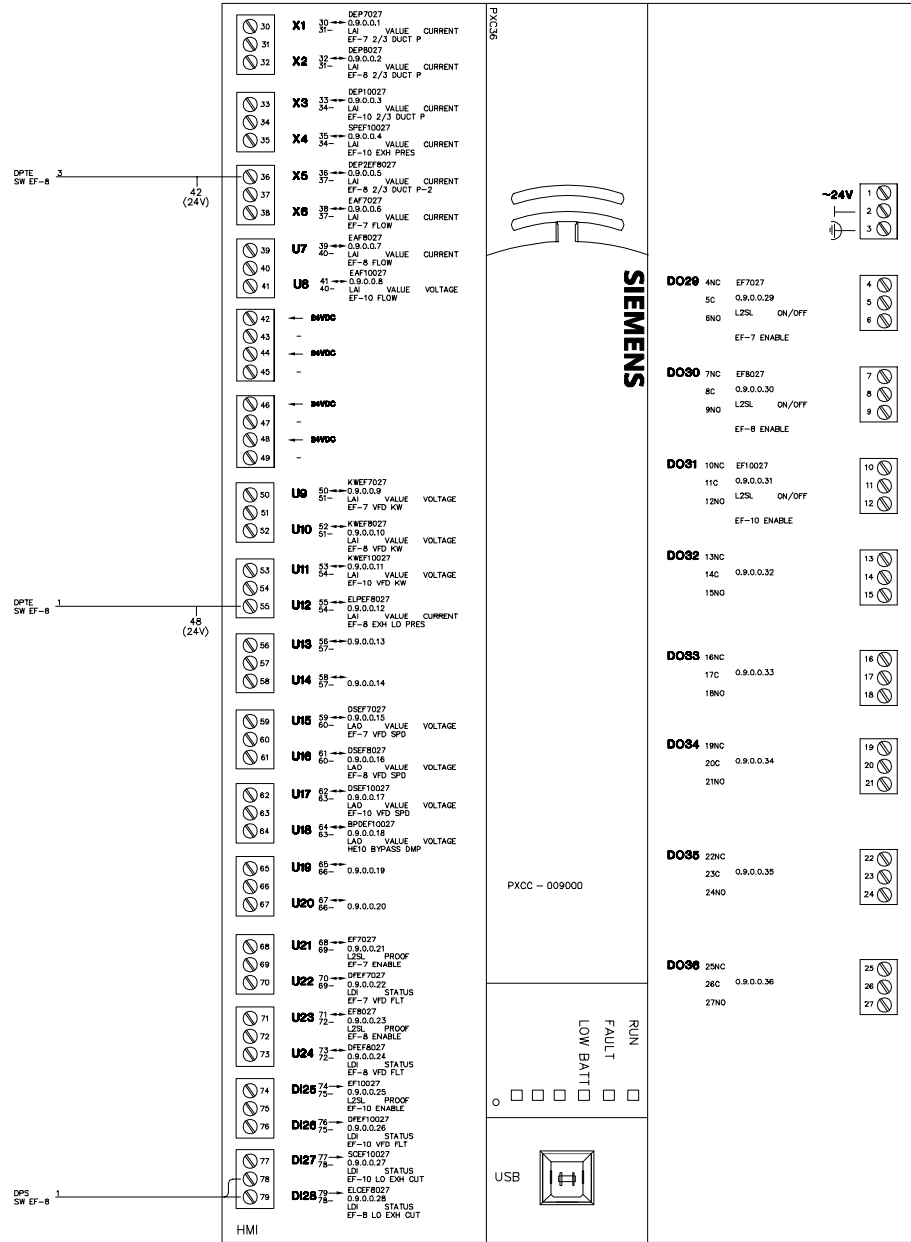
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

SWAIN EXISTING PXCC-9

44OP-388762

046



REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

SWAIN EXISTING PXCC-9

440P-388762

047

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Panel Mounted Devices					
PXCM 010000	1	PXC100-PE96.A	SIEMENS	149478	PXC MOD, P2, TX-I/O, 96 NODE, APOGEE
	1	TXA1.K24	SIEMENS	149476	@ADDRESS KEY 1-24
	2	TXS1.12F4	SIEMENS	149476	24VDC SUPPLY 1200MA, 4 A FUSE
	5	TXM1.8X	SIEMENS	149476	8 UNIV I/O MODULE W/ 4-20MA
	1	TXM1.16D	SIEMENS	149476	16 DIGITAL INPUT MODULE
	1	TXM1.6R	SIEMENS	149476	6 RELAY OUTPUT MODULE
	2	TXM1.8U	SIEMENS	149476	8 UNIVERSAL I/O MODULE

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

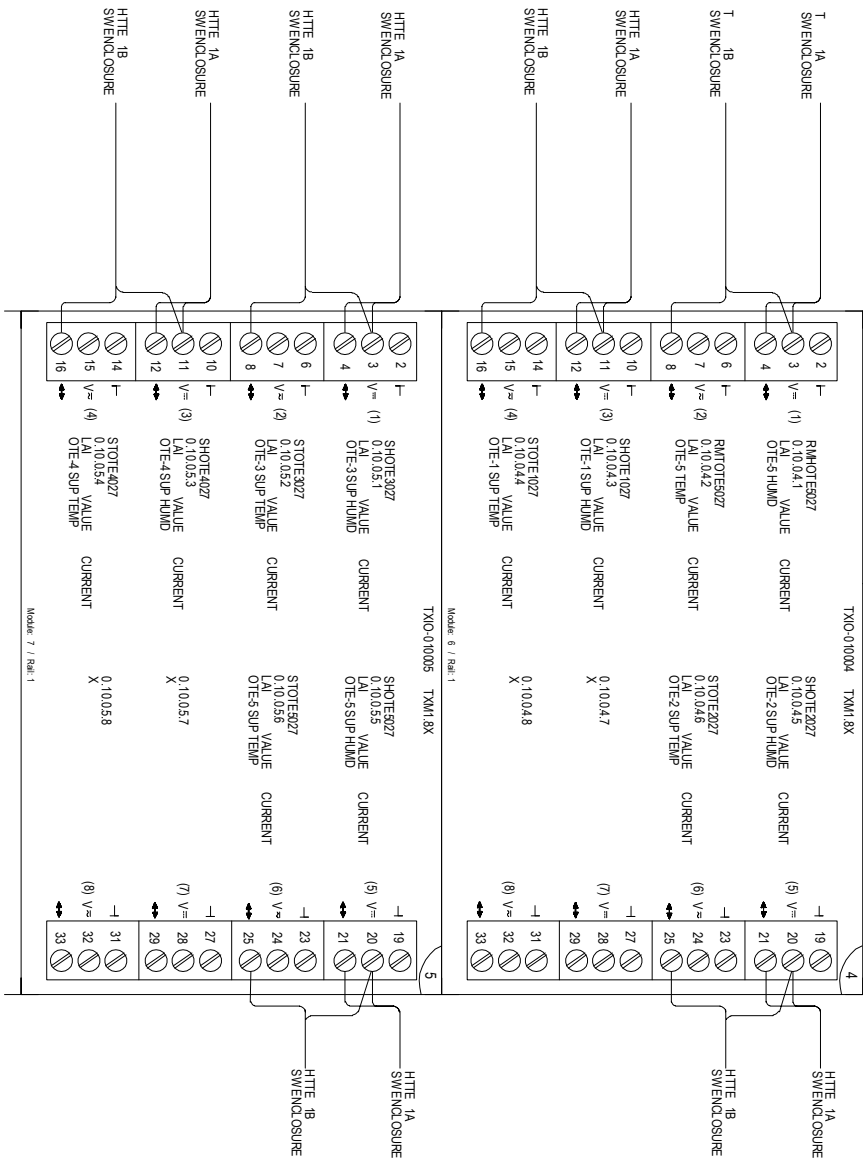
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

SWAIN NEW PXCM-10

44OP-388762

048



Model 6 / Ref. 1

Model 7 / Ref. 1

440P-388762

050

IU Research Labs Renovation

IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

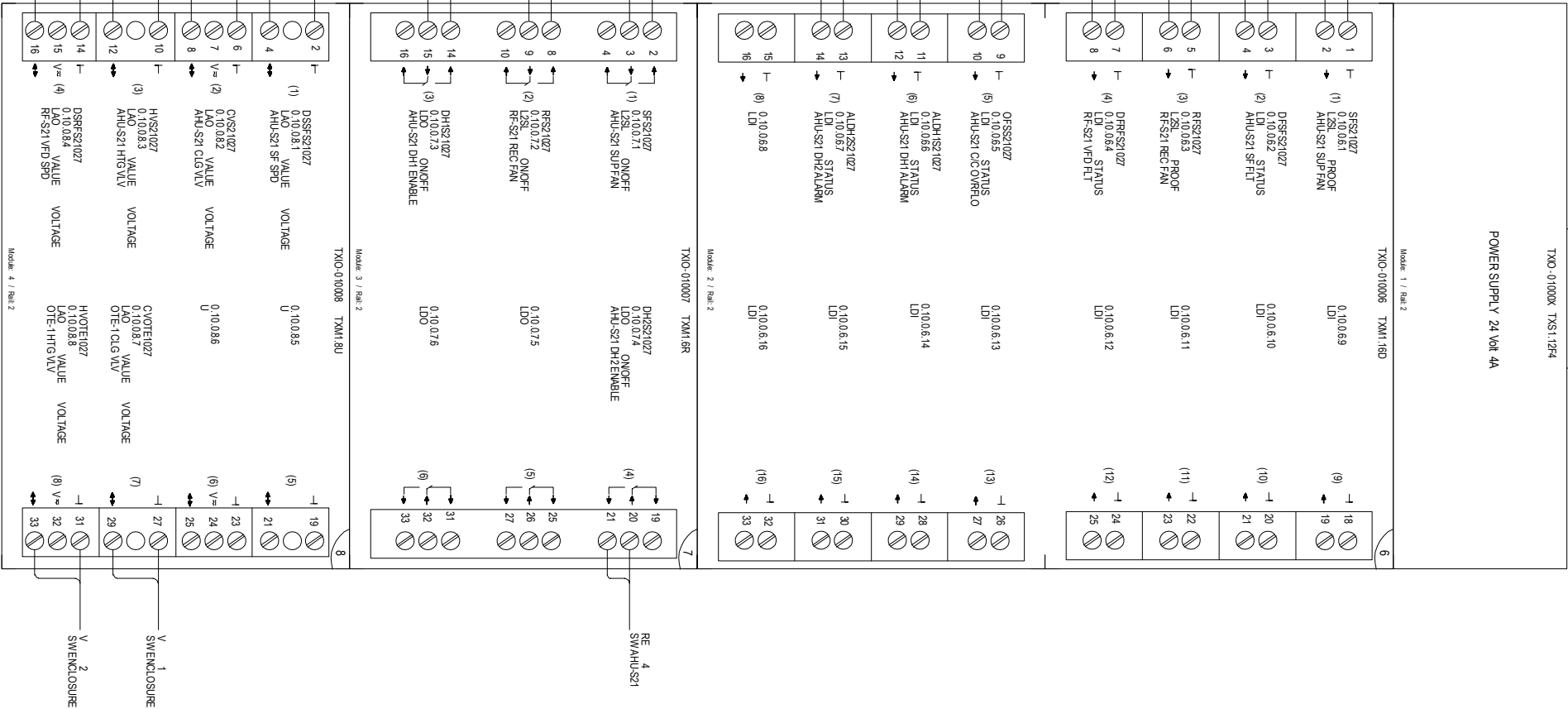
SWAIN NEW PXCM-10p002

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

REVISION HISTORY



440P-388762

051

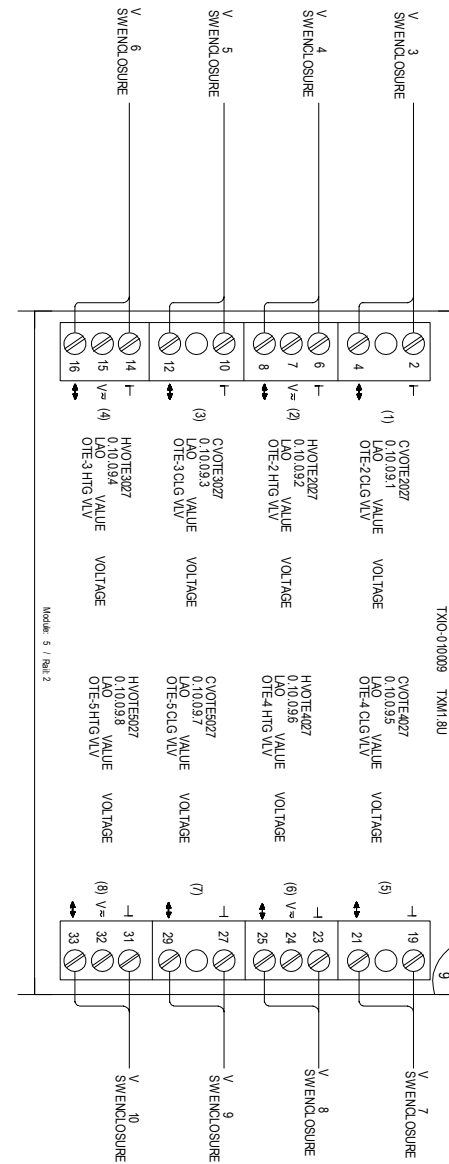
IU Research Labs Renovation				
IU PROJECT #20240397,				
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25
SWAIN NEW PXCM-10p003				

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

SIEMENS

Indianapolis
Smart Infrastructure

REVISION HISTORY



440P-388762

052

IU Research Labs Renovation				
IU PROJECT #20240397,				
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25
SWAIN NEW PXCM-10p004				

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

REVISION HISTORY

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Panel Mounted Devices					
PXCM 000	1	PXC00-E96.A	SIEMENS	149478	PXC MOD, BACNET, 96 NODE, APOGEE
	1	PXX-485.3	SIEMENS	149478	PXC MOD EXPANSION MODULE, 3 RS-485

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

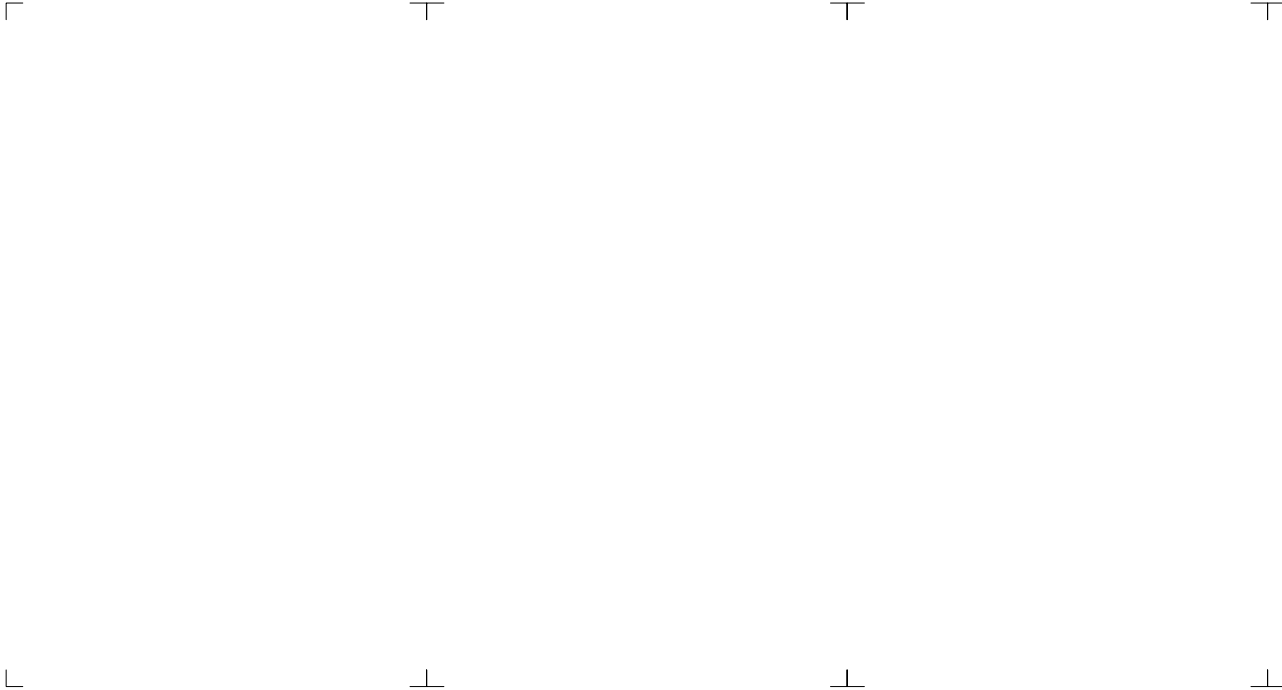
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

PXCM-3 1ST FLR FLN SOUTH

44OP-388762

053



Module 1 / Rail 1

PXCMODULAR

PXCM - 0000 PX00-E96A

REVISION HISTORY

SIEMENS

Indianapolis
Smart Infrastructure

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

PXCM-3 1ST FLR FLN SOUTH

440P-388762

054

Control Device	Qty	Product Number	Manufacturer	Document Number	Description
Panel Mounted Devices					
PXCM 000	1	PXC00-E96.A	SIEMENS	149478	PXC MOD, BACNET, 96 NODE, APOGEE
	1	PXX-485.3	SIEMENS	149478	PXC MOD EXPANSION MODULE, 3 RS-485

REVISION HISTORY

SIEMENS

3502 Woodview Trace
Indianapolis, IN 46268
USA
Phone: 317 293-8880
Fax: 866 814-3089

Indianapolis
Smart Infrastructure

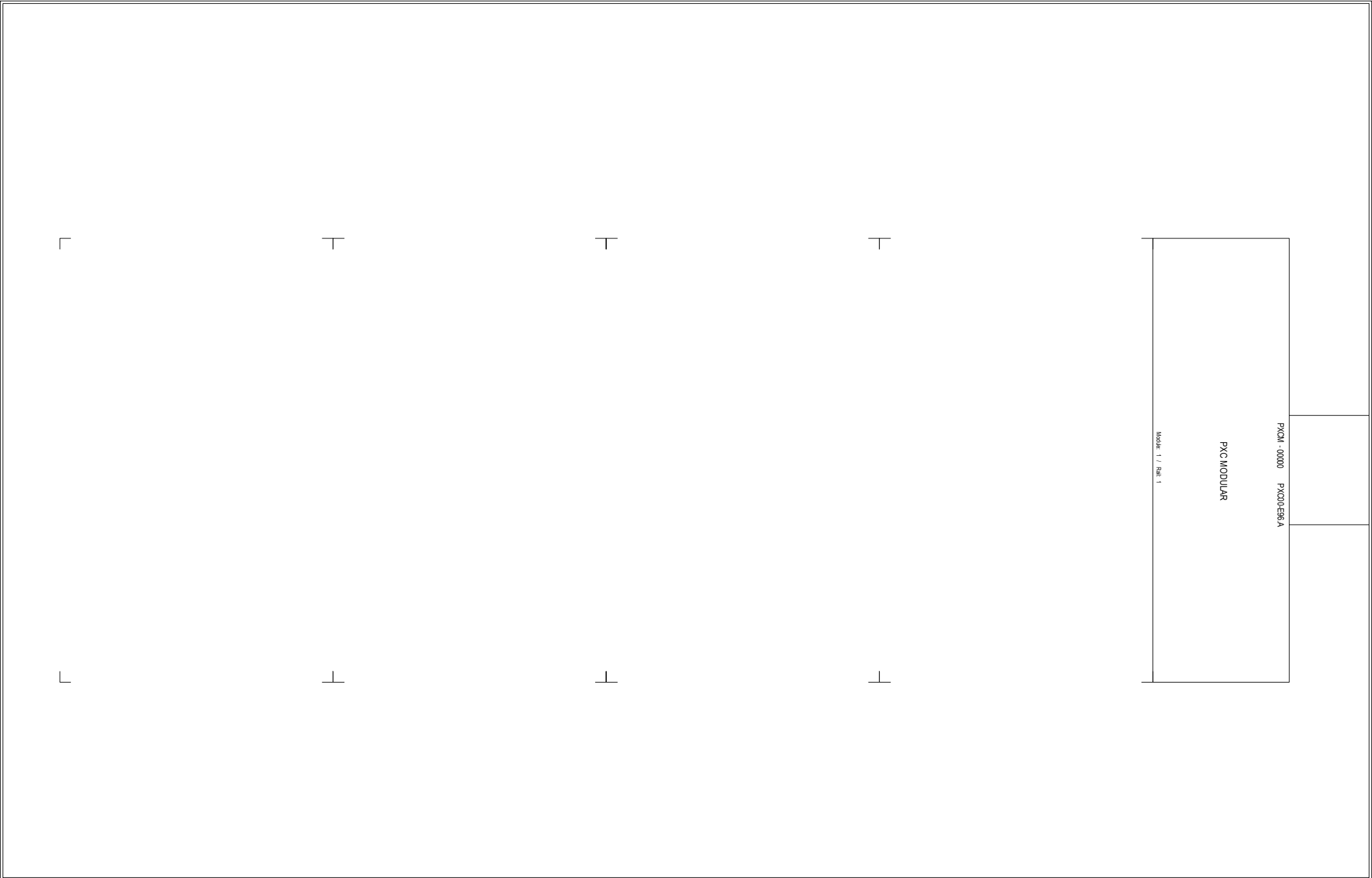
IU Research Labs Renovation
IU PROJECT #20240397,

ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE
WLH	WLH		01/17/25	01/20/25

PXCM-4 1-2 FLR FLN NORTH

44OP-388762

055



Module 1 / Rail 1

PXCMODULAR

PXCM-0000 PXCM-E96A

REVISION HISTORY		<div>SIEMENS</div> <div>Indianapolis Smart Infrastructure</div>		<div>3502 Woodview Trace Indianapolis, IN 46268 USA Phone: 317 293-8880 Fax: 866 814-3089</div>		<div>IU Research Labs Renovation IU PROJECT #20240397,</div> <table><tr><td>ENGINEER</td><td>DRAFTER</td><td>CHECKED BY</td><td>INITIAL RELEASE</td><td>LAST EDIT DATE</td></tr><tr><td>WLH</td><td>WLH</td><td></td><td>01/17/25</td><td>01/20/25</td></tr></table> <div>PXCM-4 1-2 FLR FLN NORTH</div>				ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE	WLH	WLH		01/17/25	01/20/25	<div>440P-388762</div> <div>056</div>
ENGINEER	DRAFTER	CHECKED BY	INITIAL RELEASE	LAST EDIT DATE																
WLH	WLH		01/17/25	01/20/25																